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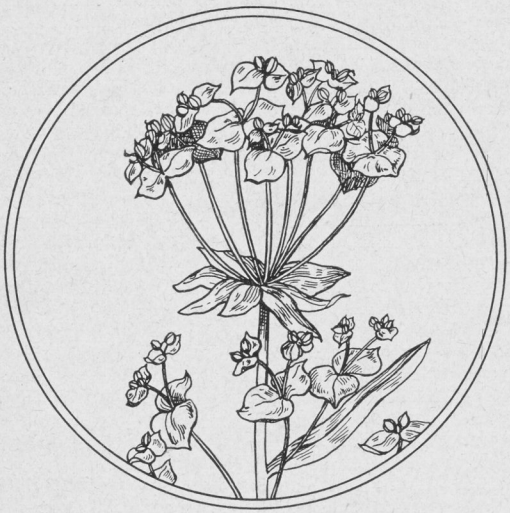
JUNE, 1944 BULLETIN P64

Noxious AND OTHER BAD WEEDS OF IOWA



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Noxious and Other Bad Weeds of Iowa

By E. P. Sylwester and R. H. Porter

Within the past 15 years weeds have come to be recognized as the cause of one of the most important losses suffered by American farmers. Experiment station and extension workers, farmers, weed commissioners, insurance companies and farm credit agencies, chambers of commerce and others either directly or indirectly dependent on agriculture have become aroused by the menace of an increased dissemination of noxious weeds.

In Iowa weeds cause a loss of many millions of dollars annually. They crowd out desirable crops, rob them of plant food and moisture, act as hosts for insects and disease-producing organisms of crops, poison or injure livestock, depreciate land values and cause extra labor in cultivation; thus they increase the cost of food production.

One of the primary causes of the weed problem in Iowa is the use of impure seed. Purity tests of clover, alfalfa, grass and grain seed made during the past 30 years by the seed laboratories at Iowa State College show that most of our bad weeds have been introduced and distributed in agricultural seed. Other factors that have made the weed problem more serious are: (1) The area of distribution of many perennial weeds has been rapidly increasing; (2) weeds the seeds of which live in the soil for years are commonly plowed under instead of being cut before the seeds are mature; (3) laxity in the enforcement of Iowa's weed law has permitted increased distribution of noxious weeds; (4) on many farms soil erosion and depleted fertility have given weeds the advantage over hay and pasture crops; (5) the increased number of tenant-operated farms employing a short-term lease, and (6) the cropping system that has been employed on about 80 percent of Iowa's tillable land for at least 25 years.

Over half the tillable area has produced corn, which is planted between May 1 and May 25. Cultivation usually is completed by the first week of July after which no further cultivation is

Note: The authors are indebted to Mrs. R. E. Lincoln for her painstaking effort in preparing many of the drawings.

given, and perennial weeds thrive until the time of killing frosts. The next largest acreage of tillable land grows spring-seeded small grains which are poor competitors of perennial weeds.

SERIOUSNESS OF THE WEED PROBLEM

The seriousness of the weed problem in Iowa can best be appreciated from the following facts obtained over a period of years by extension and experiment station workers in the Botany Department at Iowa State College:

Canada thistle is present in every county of the state, in some cases covering areas ranging in size from 40 to 140 acres.

Field bindweed is known to be in 92 counties of the state and probably occurs in all of them. It is most widely distributed in the northwestern counties where fields or farms of 20 to 160 acres are infested. Bindweed is probably the most serious weed menace to our agriculture.

Horse nettle is of southern origin and has been moving northward in Iowa until at present it is known to occur in 89 counties. It is a more persistent perennial than either Canada thistle or quack grass.

Quack grass is known to occur in 82 counties of the state, in both large and small areas. It is most injurious in those fields of the north central and northeastern sections where drainage is inadequate. Along roadsides and railway embankments it serves as an effective soil binder and in rough pasture land furnishes good forage.

Russian knapweed, perennial sow thistle, leafy spurge and perennial peppergrass are 4 of the newer perennial weeds of the state and are known to occur in 17, 18, 27 and 30 counties, respectively. Known distribution of the eight primary noxious weeds is shown on the map on the last page of this bulletin.

Further evidence of the seriousness of the weed problem and a picture of losses that have been or continue to be sustained is furnished by the following specific cases known to the extension botanists:

(1) An 80-acre field in Cherokee County is partially covered with field bindweed. It has been shown experimentally that in dry seasons this weed can reduce the yield of corn almost 90 percent. Similar areas occur in Sioux, Plymouth, Lyon and O'Brien counties.

(2) A farm in Cherokee County has leafy spurge growing in every field. It is especially serious in the pasture land. This weed has also become a problem in Sioux, Lyon, Delaware, Carroll, Plymouth and Crawford counties.

(3) Representatives of investment companies report that it is difficult to find farms without Canada thistle and quack grass in northern Iowa and that such infested farms are worth from $15 to $25 per acre less than other farms of equal fertility.

(4) Farm credit agencies are refusing to grant or extend loans on farms badly infested with field bindweed.

(5) In 1937, 35 county agents reported the use of 535,500 pounds of sodium chlorate, and 24 county agents and 27 division engineers of the Iowa Highway Commission used approximately 234,000 pounds of Atlacide. This, although it does not represent all the chemicals used in Iowa in 1937, amounts to an outlay of $76,950.

There were 1,311,000 pounds of sodium chlorate and Atlacide sold in Iowa in 1941. At the rate of 3 pounds per square rod, this amount was enough to treat 2,731 acres and required an initial cash outlay of approximately $131,000. Iowa was allotted and used 1,028,000 pounds of sodium chlorate and Atlacide annually for weed killing in 1942 and 1943.

(6) A 40-acre field in Story County prior to 1932 was practically covered with Canada thistle. In 1932 the owner paid $100 for summer fallowing and about $80 in taxes. No crop was harvested. In the summer of 1933, 10 acres produced a corn crop, another 10 acres produced an excellent crop of soybeans and sorghum and the remaining 20 acres were fallowed until fall when one half was sown to alfalfa and the other half to fall rye. This field has been farmed since 1932 in a manner that has reduced the weed population and produced crops at the same time. Now the field is practically free of thistles.

(7) A farm in Greene County in 1934 had 33 acres infested with field bindweed. The field has been farmed each year since '34 according to recommendations of the extension botanists, the bindweed is practically destroyed, and the annual net income from the field has been approximately $9 per acre for five crop seasons.

It is evident from the above statements that weeds constitute

a real problem in areas that are well adapted by soil and climatic conditions for continued high crop production. Unfortunately most of the serious perennial weeds described occur in areas where the land is best adapted by topography and fertility to permanent cropping. Continued use of these lands requires that careful consideration be given to the destruction of weeds and to the prevention of their further spread. Any program that includes more efficient use of our most productive lands or even of less favored areas certainly must provide for the solution of our weed problem.

CLASSES OF WEEDS

One of the first steps in weed control is a knowledge of the habits and methods of their reproduction. There are four main groups of weeds: Annuals, winter annuals, biennials and perennials.

ANNUALS

Annuals complete their growth in 1 year; that is, the seeds germinate in the spring or summer and the plants die in the fall. These weeds usually have either small, fibrous roots or a fleshy somewhat branched tap root. Most of the annuals produce a large quantity of seed, which in certain species retains its viability in the soil for many years. Annuals probably cause a larger total reduction in crop yields than any other class of weeds. Annuals can be controlled by prevention of seed production, through repeated close mowing, through hoeing or pulling when the plants are small, or by plowing, followed by frequent disking, harrowing and cultivation while the seeds are germinating or while the seedlings are small.

WINTER ANNUALS

Winter annuals include a small group of weeds that behave like fall wheat or fall rye although some of them may also act as true annuals. The seeds usually germinate in the fall under favorable conditions and the plants complete their growth the following spring. Growth from the root starts early in the spring; hence, these weeds are often troublesome in small grain fields or in meadows where the stand of clover or grass is thin.

Spring plowing of tilled land or mowing of other areas will destroy or prevent seed production by weeds of this class. Spring plowing should if possible be followed by clean cultivated crops.

TABLE 1. APPROXIMATE NUMBER OF SEEDS PRODUCED ANNUALLY BY AN AVERAGE-SIZED PLANT OF SOME OF OUR COMMON WEEDS.

(Courtesy O. A. Stevens, Amer. Jour. Bot., Vol. 19, 1932)

Family	Weed	Number of seeds per plant
Grass	Barnyard grass (*Echinochloa crus-galli*)	7,160
"	Green foxtail (*Chaetochloa viridis*)	34,000
"	Sandbur (*Cenchrus pauciflorus*)	1,110
"	Squirrel-tail grass (*Hordeum jubatum*)	2,420
"	Stink grass (*Eragrostis cilianensis*)	82,100
"	Wild rye (*Elymus canadensis*)	1,200
"	Witch grass (*Panicum capillare*)	11,400
"	Yellow foxtail (*Chaetochloa glauca*)	6,420
Nettle	Stinging nettle (*Urtica gracilis*)	26,600
Buckwheat	Dooryard knotgrass (*Polygonum aviculare*)	6,380
"	Red sorrel (*Rumex acetosella*)	250
"	Sour dock (*Rumex crispus*)	29,500
"	Wild buckwheat (*Polygonum convolvulus*)	11,900
Lambsquarter	Burning bush (*Kochia scoparia*)	14,600
"	Lambsquarter (*Chenopodium album*)	72,450
Pigweed	Rough pigweed (*Amaranthus retroflexus*)	117,400
Pink	Sleepy-catchfly (*Silene antirrhina*)	14,200
Purslane	Purslane (*Portulaca oleraceae*)	52,300
Mustard	Black mustard (*Brassica nigra*)	13,400
"	Penny-cress (*Thlaspi arvense*)	7,040
"	Shepherds purse (*Capsella bursa-pastoris*)	38,500
"	Tumble mustard (*Sisymbrium altissimum*)	80,400
"	Wild mustard (*Brassica arvensis*)	2,700
Rose	Cinquefoil (*Potentilla monspeliensis*)	48,600
Spurge	Leafy spurge (*Euphorbia esula*)	140
Primrose	Evening primrose (*Oenothera biennis*)	118,500
Borage	Beggars lice (*Lappula echinata*)	2,120
Vervain	Blue vervain (*Verbena hastata*)	20,000
Mint	Catnip (*Nepeta cataria*)	46,940
Nightshade	Buffalo bur (*Solanum rostratum*)	8,460
Figwort	Mullein (*Verbascum thapsus*)	223,200
Plantain	Common plantain (*Plantago major*)	36,150
Composite	Burdock (*Arctium minus*)	31,600
"	Canada thistle (*Cirsium arvense*)	680
"	Giant ragweed (*Ambrosia trifida*)	1,650
"	Marsh elder (*Iva xanthifolia*)	82,150
"	Small ragweed (*Ambrosia artemisiaefolia*)	3,380
"	Sow thistle (*Sonchus arvensis*)	9,750
"	Spanish needle (*Bidens vulgata*)	1,940

BIENNIALS

Biennials complete their growth in two seasons, behaving in a manner similar to red clover and sweet clover. Seed is produced the second season, after which the plants die. Weeds of this class may be killed the first year of their growth by cutting them at least 4 inches below the surface of the soil. During the second year of their growth, two or three cuttings are required to prevent seed production. These weeds are not difficult to destroy. Plowing, followed by clean-cultivated crops such as corn or soybeans, is the best method of control.

TABLE 2. EXAMPLES OF ANNUAL, WINTER ANNUAL, BIENNIAL AND PERENNIAL WEEDS.

Annuals	Winter Annuals	Biennials	Perennials
Butterprint *(Abutilon theophrasti)*	Downy brome grass *(Bromus tectorum)* (Also annual)	Wild carrot *(Daucus carota)*	Quack grass *(Agropyron repens)*
Cocklebur *(Xanthium commune)*	Squirrel-tail grass *(Hordeum jubatum)* (Also perennial)	Wild parsnip *(Pastinaca sativa)*	Perennial sow thistle *(Sonchus arvensis)*
Wild mustard *(Brassica arvensis)* *(B. Kaber var. pinnatifida)*	Shepherd's purse *(Capsella bursa-pastoris)*	Water hemlock *(Cicuta maculata)*	Canada thistle *(Cirsium arvense)*
Puncture vine *(Tribulis terrestris)*	Indian mustard *(Brassica juncea)* (Also annual)	Yellow rocket *(Barbarea vulgaris)* (Also perennial)	European bindweed *(Convolvulus arvensis)*
Shoofly *(Hibiscus trionum)*	Corn cockle *(Agrostemma githago)*	Hoary alyssum *(Berteroa incana)* (Also perennial)	Horse nettle *(Solanum carolinense)*
Small ragweed *(Ambrosia artemisiifolia)*	Chickweed *(Stellaria media)* (Also annual)	White cockle *(Lychnis alba)* (Also perennial)	Leafy spurge *(Euphorbia esula)*
Giant ragweed *(Ambrosia trifida)*	Prickly poppy *(Argemone mexicana)* (Also annual)	Mullein *(Verbascum thapsus)*	Perennial peppergrass *(Lepidium draba)*
Buffalo bur *(Solanum rostratum)*	Wild lettuce *(Lactuca serriola)* (Also annual)	Burdock *(Arctium lappa)*	Russian knapweed *(Centaurea repens)*
Crabgrass *(Digitaria sanguinalis)*	Chess cheat *(Bromus secalinus)*	Bull thistle *(Cirsium lanceolatum)*	Buckhorn *(Plantago lanceolata)*
Green foxtail *(Chaetochloa viridis)*	Round-leaved mallow *(Malva rotundifolia)* (Also annual)	Small-flowered buttercup *(Ranunculus abortivus)*	Sheep sorrel *(Rumex acetosella)*
Sandbur *(Cenchrus longispinus)* *(C. tribuloides* of Manuals)	Bracted plantain *(Plantago aristata)* (Also annual)	Field peppergrass *(Lepidium campestre)* (Also winter annual)	Sour dock *(Rumex crispus)*
Poverty grass *(Aristida dichotoma)*	Dog fennel *(Anthemis cotula)* (Also annual)	Evening primrose *(Oenothera biennis)*	Smooth dock *(Rumex altissimus)*
Russian thistle *(Salsola pestifer)*	Forked catchfly *(Silene dichotoma)* (Also annual)	Hounds tongue *(Cynoglossum officinale)*	Wild morning-glory *(Convolvulus sepium)*
Milk purslane *(Euphorbia supina)* (Formerly *E. maculata)*	Penny-cress *(Thlaspi arvense)* (Also annual)	Musk thistle *(Carduus nutans)*	Milkweed *(Asclepias syriaca)*
Mares' tail *(Erigeron canadensis)*	Speedwell *(Veronica peregrina)*	Spotted knapweed *(Centaurea maculosa)*	Devil's shoestring *(Polygonum coccineum)* *(P. muhlenbergii)*
Little barley *(Hordeum pusillum)*	Black mustard *(Brassica nigra)* (Also annual)	Goat's beard *(Tragopogon pratensis)*	Catnip *(Nepeta cataria)*

PERENNIALS

Perennials are plants that produce roots, rooting stems or rootstocks which remain alive for many years. Roots of peren-

nials vary in depth and extent. Plantains produce clumps of short, shallow roots; quack grass produces long rooting stems that do not extend below the plow line, and Canada thistle and perennial sow thistle have long rootstocks extending to a depth of 1 foot or more in the soil. Roots of leafy spurge and field bindweed are known to extend to depths of 15 and 20 feet, respectively. Seed production by most perennials furnishes a second method of reproduction and dissemination.

THE MOST INJURIOUS WEEDS OF THE STATE

All weeds are objectionable but some of them unquestionably are more harmful than others. The serious weeds should be attacked more intensively than others, and for that reason it is important that information pertaining to them be made available. Some of the factors that determine the seriousness of a weed follow:

(1) Ability to crowd out or lower the quality and yield of a crop.
(2) Persistence in cultivated land by:
    a. Longevity of seeds in the soil.
    b. Development of rootstocks from which new plants arise.
(3) Production of an abundance of seed.
(4) Seed readily disseminated by wind or other means.
(5) Ability to poison or injure livestock, or taint dairy or poultry products.
(6) Host for destructive diseases or insects.
(7) Expensive or time-consuming methods of eradication required.

On the basis of the above factors it is possible to classify weeds according to their seriousness and importance. It is the purpose of this circular to describe those weeds that deserve the most consideration and to outline measures for control. The weeds to be discussed are divided into three groups: (1) Most serious perennials or primary noxious weeds,* (2) weeds of secondary importance or secondary noxious weeds* and (3) other harmful weeds.

*The Iowa Weed Law classifies eight weeds as primary noxious and nine weeds as secondary noxious. For further information on the Iowa Weed Law consult Bulletin No. 81 obtainable from the State Department of Agriculture at Des Moines.

MOST SERIOUS PERENNIALS

(Iowa Primary Noxious Weeds)

The weeds in this group are those which by means of creeping roots or rootstocks are able under common methods of cultivation to take almost complete possession of farm lands. When once established, special methods of treatment are required for their destruction. The eight perennials that belong to this class are Canada thistle, field bindweed (European morning-glory or creeping Jennie), horse nettle, leafy spurge, perennial peppergrass, perennial sow thistle, quack grass and Russian knapweed. These eight are listed in the Iowa statutes as primary noxious weeds. Leafy spurge, perennial peppergrass and Russian knapweed are of comparatively recent introduction. A brief description of each weed follows.

Quack Grass *(Agropyron repens)*

Quack grass is one of the perennial grasses introduced from Europe. It produces a great deal of viable seed and develops a dense mat of underground rooting stems which form a heavy sod. If allowed to grow a few years without cultivation the roots are so tough that it is difficult to plow the land; hence it usually is desirable to use chemicals except for large areas in permanent pasture land.

This weed is especially persistent on poorly drained land and along roadsides and railroad tracks. Growth of quack grass starts early in the spring and continues until late fall. The mature stems are about 24 to 30 inches high when in head. Figure 1 illustrates the appearance of the tops and the arrangement of the underground stems.

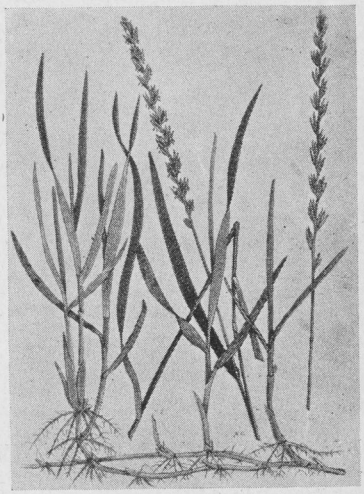

Fig. 1. Quack grass showing root development. (After Clark and Fletcher)

One grass which may be confused with quack grass is the western wheat grass *(Agropyron smithii)*. Western wheat grass

has blue-green leaves which roll inward from the margins soon after the plants are pulled, and the spikelets of the heads have 7 to 13 seeds in comparison with 4 to 7 for quack grass. The underground stems of wheat grass are finer and usually lighter in color than are those of quack grass. Quack grass leaves seldom have a blue tinge—the color is usually light or dark green, and the leaves upon drying usually remain flat.

In permanent pasture land, quack grass is not a serious weed and need not be disturbed until the field is to be planted to a cultivated crop. Livestock eat the tops readily, which prevents seed production. On steep cuts along highways or in rough land this grass acts as a soil binder. Spraying with chlorates, smother crops and summer fallowing are effective methods of control. (See pages 122 to 135.) Its known area of distribution in Iowa is shown on the map on the last page of this bulletin.

Perennial Peppergrass *(Lepidium draba)*

This peppergrass is known also as hoary cress and white top. It must not be confused with our common annual peppergrass. The map on the last page shows the known distribution of perennial peppergrass in the state, and fig. 2 illustrates the shape of the leaves, character of the tops and shape of the seed pods. Growth starts early in the spring with a rosette of green leaves covered with fine, white hairs. The plants average 15 inches in height and grow in dense patches. The blossoms are white

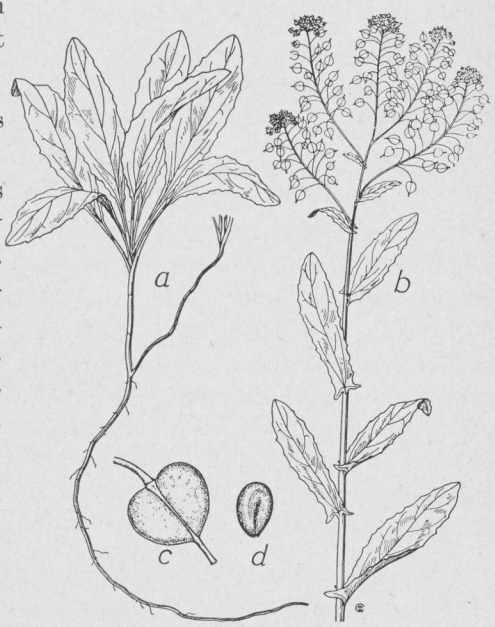

Fig. 2. Perennial peppergrass.
a. Rootstock and young plant.
b. Mature plant with flowers and fruit.
c. Fruit.
d. Seed.

and appear in late May. Mature seeds usually are produced in late June or early July after which the old tops die, and subsequent growth the remainder of the season consists largely of plants without seed stalks which grow close to the surface of the soil. Patches of this weed easily may be overlooked if not observed in June or early July.

The root system is similar to that of leafy spurge except that the roots are not as coarse and tough. Enough creeping rootstocks are produced to permit enlargement of a given area. In one field in Adair County vertical roots were found to extend deeper than 4 feet. Since reproduction takes place by both seed and roots, this weed is a serious pest. Mature seed may be produced in small grain fields and harvested with the grain. It is considered one of the worst weeds in Colorado, California and Australia. Fallowing and smother crops are the most advisable methods of controlling this weed, except for small patches which should be sprayed. Methods of control are discussed on page 119.

Leafy Spurge *(Euphorbia esula)*

Leafy spurge is one of the newer weeds that are becoming established in northwestern Iowa, the Dakotas and Minnesota. Figure 3 shows the characteristic growth of stem and branches and the shape of the leaves. The plants grow in dense patches to a height of 2 feet or more; they have an acrid, milky juice, start blossoming by the middle of May, and continue throughout the season if undisturbed. The flowers have no petals and develop into three-celled pods, each cell with a seed. When ripe the pods explode and shoot the seeds from a few to 30 feet from the parent plant. The leaf-like bracts are yellow.

The root system consists of tough rootstocks and roots which have been found to extend to a depth of 15 feet. Reproduction from the rootstocks is rapid and continuous throughout the season. It is difficult to grow crops where this weed is established. Some European writers claim that the tops are poisonous if eaten by sheep but no poisoning has been reported in Iowa. Large areas of this weed occur in Sioux, O'Brien, Lyon, Delaware, Plymouth,

Fig. 3. Leafy spurge.

Carroll, Crawford and Cherokee counties in cultivated fields, pastures, meadows and along roadsides.

Control methods are discussed on pages 119 to 135 and include spraying, smothering and cultivation. The known distribution of this weed in Iowa is shown by the map on the last page of this bulletin.

Field Bindweed *(Convolvulus arvensis)*

This weed, known also as European morning-glory, small-flowered morning-glory, creeping Jennie and pea vine has been on the increase in Iowa for a number of years. In fact, it has been increasing its area of distribution at an alarming rate. According to some authorities an infestation of bindweed under normal conditions tends to double its area every 5 years. It is primarily a creeper, not a climber. The plants produce a dense covering over the surface of the soil, and with their deep and extensive root systems they rob corn and other shallow-rooted crop plants of water, with serious results in dry seasons.

Figure 4 shows the typical shape of the flowers and leaves. The flowers are bell-shaped, about 1 inch in diameter and white or pink. It is not uncommon to confuse this morning-glory with the common wild morning-glory, but the latter has larger,

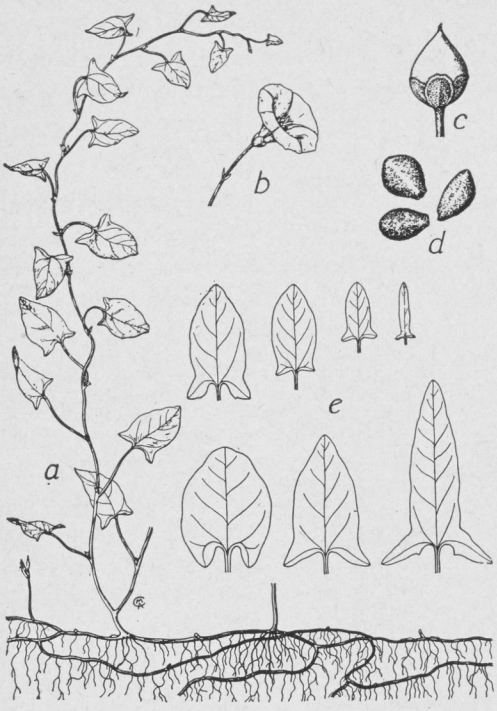

Fig. 4. Field bindweed.
a. Plant attached to rootstocks.
b. Flower.
c. Fruit.
d. Seeds.
e. Types of leaves from plants grown from seed.

more pointed leaves, the flowers are larger and the plants usually climb more readily on other plants. The common wild morning-glory does not grow as rapidly as the European form, and it does not form as dense a carpet or mat on the surface of the soil.

The roots of the field bindweed have been found to extend to a depth of 20 feet in the Missouri loess area in Sioux County, and if plants are cut off during the summer near the surface of the soil, new shoots may appear in 2 or 3 days. The plants blossom continuously if undisturbed, and seed may be produced in midsummer or later. Seed production is favored by dry soil and warm, dry, clear weather. More than 85 percent of mature bindweed seeds are impermeable to water and will not grow at once. From 10 to 25 percent may grow the second year after passing the winter in the surface soil. Seed of field bindweed is frequently found in threshed samples of oats, wheat, rye and barley. This weed occurs in gardens, lawns, pastures, nurseries, cultivated fields and waste places. As soon as an area is discovered, immediate steps should be taken to destroy all plants either by spraying or by cultivation. (See pages 119 to 136.) The known distribution of this weed in Iowa is shown on the last page of this bulletin.

Horse Nettle *(Solanum carolinense)*

Horse nettle, also called bull nettle, is a member of the nightshade family. It grows to a height of 2 feet and is a deep-rooted perennial. Its roots have been found to extend to a depth of 8 feet. The vertical rootstocks die back to a depth of about 18 inches in the winter, but new shoots arise from below that point, coming up in late June. The plants if undisturbed grow rapidly, blossom in late July or August and produce mature seed in September. The first killing frost prevents further growth of this weed. Lateral rootstocks are not so common as with Canada thistle; a fact which probably explains why the plants do not spread so rapidly from roots. One characteristic of this plant is the stiff spines which are produced on the main stem, the branches and on the underside of the leaf midrib. This feature makes it undesirable for nettles to be present in hay meadows. The blossoms are shaped like those of the tomato and usually are purple or whitish. (See fig. 5.) The seeds are borne in small green fruits or berries which usually become yellow brown when ripe. Mature seeds of horse nettle are frequently found in red clover seed and in seed lots of Korean lespedeza grown in the South, and seed and berries are frequently present in soybean seed.

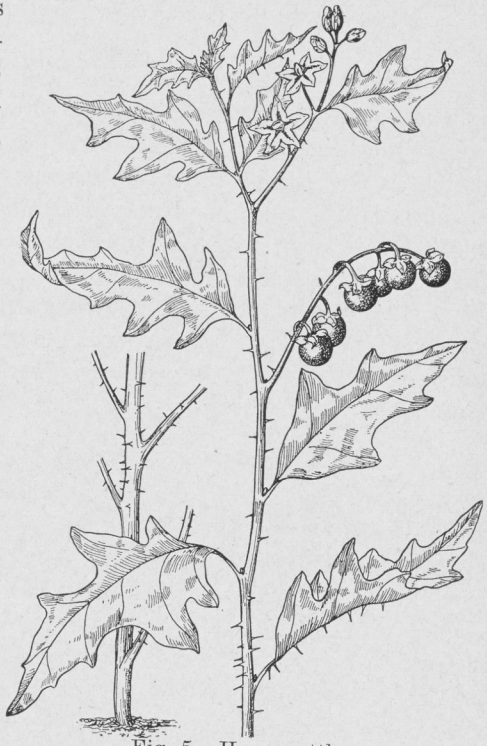

Fig. 5. Horse nettle.

This weed may be controlled by spraying, by smothering with alfalfa and by summer fallowing as described on pages 117 to 136. The known distribution of this weed in Iowa is shown by the map on the last page of this bulletin.

Canada Thistle *(Cirsium arvense)*

Canada thistle is present in every county in Iowa but is most serious in the central, north central, eastern and northeastern sections. The persistence of this weed in fields, pastures and meadows is well known. It grows in dense patches, which distinguishes it from bull thistle common in pastures and waste places. Figure 6 shows a thistle plant, illustrating the type of leaves and flowers, the shape of the seed and the underground roots and rootstocks. The flower clusters are usually purple but may occasionally be white. They are about 1 inch in diameter.

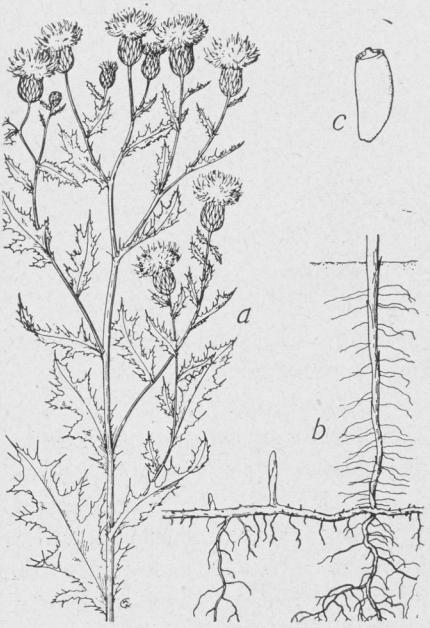

Fig. 6. Canada thistle.
a. Mature plant in flower.
b. Rootstock with old stem and young sprouts.
c. Seed.

Roots and Rootstocks

The root system of Canada thistle may extend several feet into the soil, depending on soil texture and methods of tillage. In permanent pasture land the major portion of the root system is within a foot of the surface, but in loose, well-tilled land it may extend to a depth of 6 feet or more. Usually an abundance of rootstocks is produced which extend diagonally into the soil or parallel to the surface. From these rootstocks new shoots arise from early spring until late

fall. One plant is often the beginning of a constantly enlarging area.

The rootstocks serve for food storage and vegetative reproduction. It has been found that the food reserves of roots in undisturbed areas usually are lowest during the blossoming period and highest in the early spring months. This means that top growth after blossoming supplies food materials to the root system. Any method of eradication therefore, to be successful, must be one that prevents top growth from the first of June until the end of the growing season.

Seed Production

There is a common but mistaken impression that the Canada thistle does not produce seed in Iowa. Members of the Botany Department and Extension Service of Iowa State College have collected mature viable seeds from many different sections of the state, but fortunately the amount of seed is limited by the seeding habits of the plants. There are two kinds of flowers, staminate or pollen-producing flowers and pistillate or seed-producing flowers. Each individual plant has but one kind of flower that functions, a condition which explains why seed production is limited. For example, one patch may have originated from a single seed, in which case all of the plants would be of the same kind. If the flowers were staminate no seed could be produced; if they were carpellate or female flowers, seed production would be dependent on the transfer of pollen from staminate flowers in a nearby infestation. In large areas both types of plants usually occur; hence pollination followed by seed production is more readily accomplished.

Varieties

There are many variations among Canada thistle plants. Some have nearly smooth leaves with few spines; others have crinkled or rugose leaves, cut in deeply at intervals along the margins and well supplied with spines, and still other varieties fall in between the two extremes. Cross-fertilization occurs readily, from which different types arise. This variation confuses farmers, and in many cases patches of this thistle are allowed to remain because it is not recognized. In case of doubt, specimens for identification should be sent to the Extension Service, Iowa

State College, Ames, Iowa. Several years of hard work may be saved by having doubtful plants identified when first observed.

Methods of Control

The most effective control measures consist of spraying small areas, cultivation in growing crops, summer fallowing and smothering with alfalfa. A discussion of each of these methods for thistles and other perennials will be found on pages 117 to 136.

Russian Knapweed *(Centaurea repens)*

Another member of the most serious group of weeds is Russian knapweed. It is one of the newer perennial weeds of the state. Its known distribution in Iowa is shown on the map on the last page of this bulletin. Mature plants resemble the bachelor button which is a close relative. The stems are downy and branch from near the base. The flowers are purple and about ¾ inch in diameter. Blossoming takes place in July, and mature seed may be found during that month. Mature plants are about 2-3 feet high. The root system consists of tough, deep roots and creeping rootstocks. This weed occurs in cultivated fields and along roadsides and when once established spreads rapidly by its roots. In many western states it is one of the most serious weeds, and in Iowa it has readily taken possession of farm lands. Farmers should watch carefully for this pest. (See fig. 7.) Control methods consist primarily of treatment

Fig. 7. Russian knapweed.
a. Mature plant in flower.
b. Rootstock with old stem attached.
c. Seed.

with chemicals, smother crops and summer fallowing. (See pages 119 to 136.)

Perennial Sow Thistle (*Sonchus arvensis*—smooth variety) (*S. arvensis var. glabrescens*—hairy variety)

The perennial sow thistle has been present in parts of Iowa for many years but is not yet as serious as several other perennial weeds. Its area of known distribution is shown on the map on the last page. It occurs in cultivated fields and waste places, is apparently finding its way into new localities, and people should be on the lookout for it. The mature plants are about 2 feet high, contain a milky juice, and blossom in June, producing large, orange-yellow flowers similar to a dandelion blossom. (See fig. 8.) An abundance of seed is produced which is readily scattered by the wind. The leaves are similar to those of wild lettuce except that no short bristles are produced on the underside of the leaf midrib. The root system of sow thistle is similar to that of Canada thistle except that the rootstocks usually are shallower. Methods of eradication are similar to those for Canada thistle.

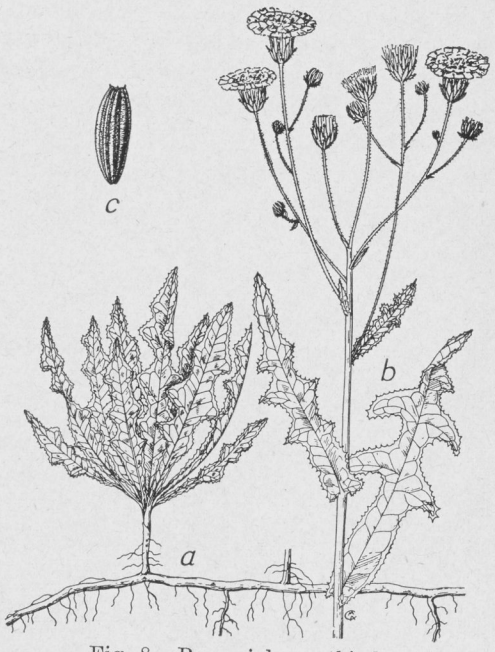

Fig. 8. Perennial sow thistle.
a. Rootstock with young plant.
b. Mature plant in flower.
c. Seed.

WEEDS OF SECONDARY IMPORTANCE
(Iowa Secondary Noxious Weeds)

The weeds in this group are widely distributed in Iowa. They produce an abundance of seed which, with the exception of

cocklebur and wild carrot, retain their vitality in uncultivated soils for long periods of time. Many of them occur in meadows, pastures and along roadsides, and the remainder are pests in cultivated fields. Cultivated crops can be grown in infested fields by practicing clean cultivation, but the value of the seed crop is reduced. Prevention of seed production and the use of clean seed are the most important control measures. The nine weeds in this list are buckhorn, buttonweed, cocklebur, sheep sorrel, smooth dock, sour dock, wild carrot, puncture vine and wild mustard. All of these weeds are classed as secondary noxious according to the Iowa Weed Law.

Sour Dock *(Rumex crispus)*

Sour dock is much more of a problem on farms than smooth dock. It occurs in meadows, pastures, along roadsides and occasionally in cultivated fields. The root is fleshy, perennial in habit and yellow beneath the bark. (See fig. 9.) Sour dock seeds are commonly distributed in seed of red clover, sweet clover, timothy and sometimes in alfalfa. After rains in the spring the plants can usually be pulled. All plants should be cut or pulled before seed production. The same control measures recommended for smooth dock are of value.

Fig. 9. Sour dock.

Smooth Dock

(Rumex altissimus)

This weed grows in waste places, meadows and pastures. It has a perennial, somewhat branching fleshy root but has no spreading rootstocks. (See fig. 10.) Clean cultivation, crop rotation and use of clean seed are effective control measures. Badly infested areas may be pastured heavily with sheep for one season and this in turn followed by plowing and planting clean-cultivated crops like corn or soybeans.

Fig. 10. Smooth dock.

Red Sorrel *(Rumex acetosella)*

Red sorrel, also called sheep sorrel or horse sorrel, is the only weed in the secondary noxious list which has creeping rootstocks. (See fig. 11.) The plants increase from the roots readily in poorly tilled land and to some extent in pastures and meadows. Sour, thin soil is a common location for red sorrel although it will grow in sweet, fertile soil. In poor soils red sorrel crowds out many crop plants. Red sorrel seeds early in the summer, but the seed may remain on the plants for a long time. For this reason red sorrel seed is a common impurity of timothy, red clover and alsike clover seed. This weed may be controlled by clean cultivation, use of clean seed, mowing to prevent seed production, by applying lime and manure and by reseeding to legumes. Sodium chlorate or Atlacide may be used to destroy small areas. (See page 111.)

Fig. 11. Red sorrel.

a. Rootstock with mature plants.
b. Branch in fruit.
c. Mature fruit with outer coverings.
d. Naked fruit (seed).

Fig. 12. Wild mustard.

Wild Mustard
(Brassica arvensis)
(B. Kaber var. pinnatifida)

Wild mustard is a common pest of grain fields, especially in seasons of high spring rainfall. Mature plants are often 2 to 3 feet high, stems are smooth or hairy and the flowers are yellow. (See fig. 12.) Seeds of most mustards remain alive in the soil for 20 to 40 years and are common impurities of flax, oats, barley and wheat. Crop rotation and the use of clean seed are effective measures of control in Iowa. All small grain seed should be thoroughly cleaned before sowing. Heavily infested areas should be put into clean-cultivated crops such as corn or soybeans.

Puncture Vine *(Tribulus terrestris)*

Puncture vine, also known as caltrop, ground burnut and tackweed, is found in southwestern Iowa and other scattered areas in the state. Fortunately it is not very abundant. It is

common on sandy land and thrives during hot, dry weather. This weed is a prostrate annual with jointed slender stems and has been reported to be poisonous to sheep. The stems are 1 to 3 feet long and are covered with short, silky hairs. The small, yellow flowers are about ½ inch in diameter and consist of 5 petals. The plant is illustrated in fig. 13. A cluster of 5 burs is formed from each flower. Each bur contains 2 to 5 seeds and has 2 or more sharp spines which are injurious to all classes of livestock. The plant reproduces only by seeds that remain viable in the soil for many years. Formation of seed, therefore, should be prevented. The plants should be cut off below the crown or pulled when they first appear. If the plants are in fruit, they should be cut and then burned. Spraying with weed-killing chemicals or crankcase oil, followed by burning on the spot when the weeds are dry, is also an effective way of combatting this pest.

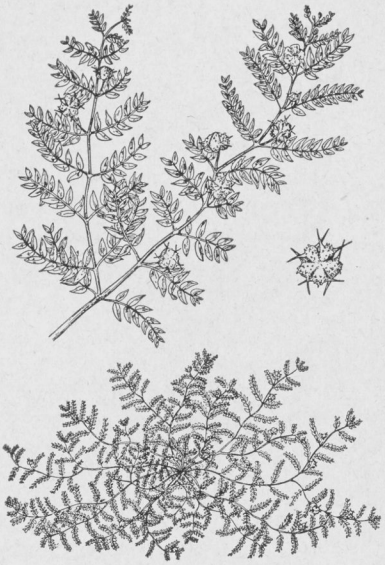

Fig. 13. Puncture vine.

Buttonweed *(Abutilon theophrasti)*

This weed is an annual, but its seeds retain their vitality in the soil so long that many people think it is a perennial. Mature plants are frequently 6 feet high with few branches, the leaves are broad and soft like velvet, the flowers are 1 inch in diameter and yellow. The seeds are borne in a capsule shaped like a butter print and about ¾ inch in diameter. (See fig. 14.) Prevention of seed production and destruction of germinating seedlings are effective measures of control. Seeding heavily infested areas to small grain followed by early plowing and summer fallowing will accomplish this without loss of crop.

Fig. 14. Buttonweed.

Fig. 15. Wild carrot.

Fig. 16. Cocklebur.

Fig. 17. Buckhorn.

Wild Carrot *(Daucus carota)*

Wild carrot is more common in the eastern states than in Iowa where it occurs principally in the southern half of the state in clover fields, pastures, along roadsides and in waste lots. Like the cultivated carrot it is a biennial, producing no seed until the second year of its growth. (See fig. 15.) Its seeds are a common impurity of red clover seed. Wild carrot will not withstand cultivation, hence crop rotation and use of clean seed are effective control measures. Plowing, followed by clean-cultivated crops, controls it readily.

Cocklebur (Xanthium commune)

This weed is familiar to most farmers and needs no description. (See fig. 16.) It grows principally in cornfields after the crop is laid by and in small grain fields after harvesting. Seeds are produced in cornfields on large plants in late summer and also prior to killing frosts. Each bur has two seeds, one of which usually germinates at least a year before the other. The seeds do not retain their vitality in the soil for more than 3 or 4 years, hence the principal method of control is to prevent seed production. This may be done by pulling plants in cornfields early, mowing or plowing of small grain stubble or by seeding land to alfalfa. Hogs may be poisoned by eating cocklebur seedlings in the two-leaf stage.

Buckhorn *(Plantago lanceolata)*

Buckhorn is a perennial in the plantain family. It grows in clumps with numerous short, thick seed heads somewhat like those of timothy. The leaves are long, lance-shaped, dark green and have prominent veins. Figure 17 shows the plant characteristics.

This weed occurs especially in the southern half of the state. It is found in clover fields and pastures of low fertility, and is frequently a pest in lawns. Seed of buckhorn is commonly found in red clover and timothy seed. The weed will not withstand cultivation. Plowing, followed by clean-cultivated crops, will control it readily. Small grain, followed by early plowing, will control it also.

OTHER HARMFUL WEEDS

The weeds listed in this class are either less widely distributed or less serious than those in the primary and secondary noxious groups. It is probable that in a few years some of them will be classed as noxious by the state weed law. Seeds of about half of the members of this group are distributed in crop seed but to a much less degree than are seeds of the secondary group. Under certain conditions the weeds in this third group are troublesome, and since they are far more serious than many other common weeds, a brief description of each one is presented. The list consists of the following weeds:

Family	Common Name	Family	Common Name
Grass	Crabgrass	Milkweed	Whorled milkweed
"	Sandbur	"	Climbing milkweed
"	Porcupine grass	Morning glory	Annual morning-glory
"	Triple awn grass	" "	Wild morning-glory
"	Downy brome grass	Vervain	Hoary vervain
"	Squirrel-tail grass	Mint	Germander
Nettle	Wild hemp	"	Motherwort
Buckwheat	Devil's shoestring	Potato	Buffalo bur
"	Wild buckwheat	Figwort	Mullein
Mustard	Penny-cress	Composite	Tarweed
"	Marsh cress	"	Daisy fleabane
"	Yellow rocket	"	Curled thistle
Rose	Cinquefoil	"	Scabious knapweed
"	Wild rose	"	Spotted knapweed
Legume	Wild licorice	"	Chicory
Cashew	Poison ivy	"	Goat's beard
Carrot	Sicklewort	"	Wild lettuce
Milkweed	Common milkweed		

Crabgrass *(Digitaria sanguinalis)*

This plant (fig. 18), also known as turkeyfoot, crowfoot, finger grass or water grass, is well known and needs no further description. It makes its appearance in late June and its heaviest growth is during the hot, dry months of July and August. It is an annual belonging in the grass family, and is a weedy pest in fields, lawns and gardens during the late summer and early fall months.

Since it is an annual, any method that prevents seed production will eventually control it. In gardens, pulling or thorough, clean cultivation throughout the summer will control this pest. In lawns, however, it is impossible to clean cultivate or mow close enough to prevent all seed production. Several rakings followed by repeated mowings will destroy more of these plants than

Fig. 18. Crabgrass.

will single mowings. This procedure can be followed in lawns and should be coupled with judicious regular fertilizing, top dressing with peat or rich black soil and reseeding with lawn mixtures high in bluegrass, redtop and white Dutch clover. Planting trees to provide shade will also help alleviate infestation from this plant. High mowing of the bluegrass also will help establish a thrifty sod. The clippings should be allowed to remain as a mulch. By observing these recommended practices, infestations of crabgrass can be kept at a minimum.

Sandbur *(Cenchrus longispinus)* *(C. tribuloides* of Manuals)

This plant (fig. 19), which becomes a serious pest in practically all types of land, is an annual, reproducing only by seeds. It is so well known that it needs no further description. It is found to some extent throughout the entire state.

Since it is an annual, any method that prevents seed production will control this plant. Clean cultivation, hoeing, pulling, or spraying with old crankcase oil followed by burning are all methods of controlling this weed on small areas. For large areas, fall seeded rye or wheat, or early maturing spring-seeded

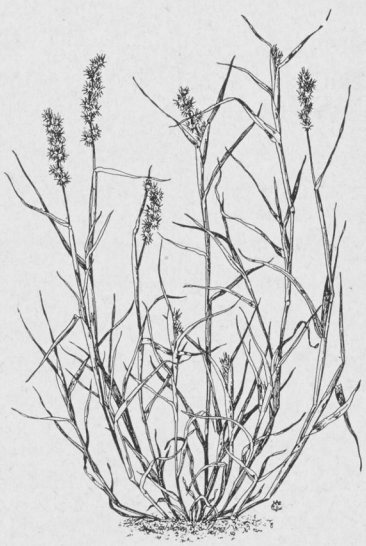

Fig. 19. Sandbur.

Fig. 20. Porcupine grass.

small grain, followed by early plowing and regular fallowing operations to prevent all seed production, will control this pest if practiced several years in succession.

Porcupine Grass *(Stipa spartea)*

This plant (fig. 20), which also is known as needle grass, is a perennial of the grass family. It is a native in this area. At the present time it is found primarily in dry, native grasslands and meadows, along fencerows, railroad embankments and roadsides.

The tufted stems of this plant are erect and stout, usually about 3 feet high. The leaves have mostly flat blades, the sheaths usually overlapping, and the entire plant is extremely coarse. The seeds are yellowish-brown in color, ½-¾ inch long, and possess a single, long, twisted awn. This awn, which reacts with moisture conditions in the atmosphere, serves to "auger" the seed into the soil. It very often causes serious mechanical injury to the mouth and eye parts of grazing animals. The seeds which sometimes fall on grazing sheep cause dockage in wool as well as injury to the skin of the animals.

Close mowing or very close grazing early in the season will help control seed production of this plant. Heavily infested areas should be plowed and planted to clean-cultivated crops before the area is reseeded.

Triple Awn Grass or Poverty Grass
(Aristida dichotoma* and *Aristida oligantha)

These two species of grass, often called wire grass, are both annuals, reproducing only by seeds. Both species are native

in North America and widespread throughout the United States. These grasses are found on infertile areas such as dry grasslands and sandy or gravelly, overgrazed, neglected or eroded areas where soil fertility is low. One of the species is shown in fig. 21.

Fig. 21. Triple awn grass.

The stems of this plant are branched at the base and attain a height of about 1 foot. The leaves have narrow, inrolled blades and loose sheaths. The spikelets are borne in slender, flexuous, few-flowered panicles. Each seed is terminated by a three-forked awn. These awned seeds may cause serious mechanical injury by working their way into the skin, tender mouth parts and eyes of grazing animals.

Since these plants are annuals, they do not persist under clean cultivation. Large, heavily infested areas should be put into cultivated crops if land contour and other conditions permit. The area may be reseeded after 2-3 years of such cultivation. In areas such as steep rolling pastures, the adoption of a pasture improvement program involving the use of lime, manure and phosphates, coupled with the seeding of legumes and prevention of overgrazing, will gradually crowd out these undesirable weeds. Further information on pasture improvement may be obtained from the Agronomy Department at Iowa State College.

Downy Brome Grass *(Bromus tectorum)*

Downy brome grass (often incorrectly called wild oats) behaves either as an annual or winter annual, reproducing only by seed. It is rapidly becoming a serious weed in waste places, pastures, meadows, roadsides, railroad embankments and alfalfa fields. Originally introduced from Europe, it has become widespread throughout the United States. The plant grows about 10-15 inches in height, usually in dense patches. The stems are

Fig. 22. Downy brome grass.

slender and the leaf blades and sheaths are densely pubescent. The head is dense and drooping and the seed is slender, reddish-brown and awned. (See fig. 22.) The awn, because of its brittleness and barbed characteristics, may cause serious mechanical injury to the mouth and eye parts of grazing animals.

Any method that prevents seed production will control this plant. Repeated close mowing or repeated spraying with crankcase oil or chlorates when the plants are small, followed by burning, is advisable for small areas. For extensive, heavily infested areas, spring plowing followed by such clean-cultivated crops as corn or soybeans will control this plant.

Japanese brome grass *(Bromus japonicus),* also called Japanese chess, is closely related to downy brome grass. The plant is an annual, attains a height of 1-2½ feet and resembles downy brome grass, but has a more spreading, diffuse, drooping head. The branches are flexuous, the individual spikelets somewhat flattened, and the seeds have a twisted, flexuous smooth awn which is ¼-½ inch long.

This weed is becoming a problem in land seeded to smooth brome grass *(Bromus inermis).* Seeds of this plant when mixed with agricultural grass seeds are almost impossible to remove, even with the best available cleaning equipment. It would be advisable to eliminate these plants from a field before a seed crop is harvested. Farmers are urged to buy only high quality seed and to watch for this pest and eliminate it as soon as discovered and before it becomes established. The control for this plant is similar to that discussed under downy brome grass.

Squirrel-tail Grass *(Hordeum jubatum)*

This grass, also called wild barley, behaves either as a biennial or perennial, reproducing only by seed. It is found in meadows, pastures, along roadsides and in waste places. It is a native of North America and has become widespread throughout Iowa. It is illustrated in fig. 23.

Fig. 23. Squirrel-tail grass.

The plants usually grow in tufted bunches, attaining a height of about 12 inches. The nodding heads are somewhat drooping and the numerous awns are slender and barbed. When the heads are mature they usually fall apart. When grazing animals eat this grass, or hay which contains it, the barbed awns sometimes work into the tender tissues of mouth and eyes, causing wounds and ultimate infection.

Extremely heavy pasturing with cattle or sheep early in the spring before the heads are produced will give this grass a severe setback. This should be followed, however, by plowing and clean-cultivated crops for several years before the area is reseeded to pasture.

Wild Hemp *(Cannabis sativa)*

Wild hemp is a member of the nettle family and its cultivated form is grown extensively throughout the world for its fiber, which is used in making cloth and rope. Wild hemp is an annual which occurs abundantly in overflow land and along fencerows in low, recently drained areas. Two types of plants are produced, seed-bearing and pollen-producing. An abundance of seed is produced but does not live in the soil for more than 1 or 2 years. Prevention of seed production is the only method of control. This can be done by early and repeated mowing, or

Fig. 24. Wild hemp.

by late plowing followed by any type of clean-cultivated crop. Figure 24 illustrates the plant.

This plant recently received a lot of publicity as the source of the narcotic drug marihuana. For a more detailed discussion of this weed, obtain P.D.-457 or Plant Life of Iowa, Vol. I, No. 1, available from the Agricultural Extension Service, Ames, Iowa.

Devil's Shoestring ***(Polygonum coccineum) (P. muhlenbergii)***

Devil's shoestring is frequently called tanweed and marsh smartweed. It is a perennial with tough, red rootstocks. (See fig. 25.) It is native to our Iowa swamps. Drainage of lowlands has permitted cultivation, but this weed still remains. It does not prevent the production of corn, but in some sections the

Fig. 25. Devil's shoestring.

weed is increasing its area of distribution. Blossoming is not abundant, especially in well-drained peat beds, but occasionally the bright rose-colored flowers may be found, followed by brown triangular seed with rounded smooth edges. Cutting the young plants is essential in the control of this weed. Small grain followed by early plowing and thorough spring tooth harrowing whenever new growth appears is an essential step in controlling this weed. Roots which are thus brought to the surface should be raked up and burned. The following year, heavy smother crops such as sorghum, sudan grass or millet should be put on the area. Alfalfa also may be seeded if soil conditions are suitable.

Fig. 26. Wild buckwheat.

Wild Buckwheat *(Polygonum convolvulus)*

This plant (fig. 26), also known as black bindweed, is an annual of the buckwheat family. It is very often confused with the field bindweed or "creeping Jennie." A comparison of the picture of this plant with that of the field bindweed will readily show outstanding differences.

Originally introduced from Europe, this plant has become widespread throughout the northern United States and Canada where it grows in cultivated fields, small grain fields, gardens, waste areas and along fencerows. The roots of this plant are brown, fibrous, very shallow and consequently easy to pull. The creeping, twining or climbing stems are branched at the base. The entire, simple, heart-shaped leaves are alternate on the stem. The white flowers are very small and borne in clusters or racemes. The triangular seed is dull black and minutely roughened.

Hand weeding or hoeing is the best method of control for small areas. Spraying with old crankcase oil is effective along fencerows. For large areas, clean-cultivated crops will tend to keep this weed under control. Close pasturing usually will prevent seed production. Harrowing when the seedlings are small also will kill a great many plants.

Penny-Cress *(Thlaspi arvense)*

Stinkweed, fanweed and Frenchweed are other common names given to penny-cress. This weed is a winter annual (sometimes annual) of the mustard family. Few weeds come into blossom and produce mature seed earlier than does penny-cress. Seeds

of this plant are frequently introduced in alfalfa seed, and the plants mature seed before the first crop of hay is cut, thus reseeding themselves for the next year. The plants should be pulled when in blossom, or if the area is too large, it should be mowed before any seeds are formed. This weed is illustrated in fig. 27. Large, heavily infested areas should be put into clean-cultivated crops such as corn or soybeans.

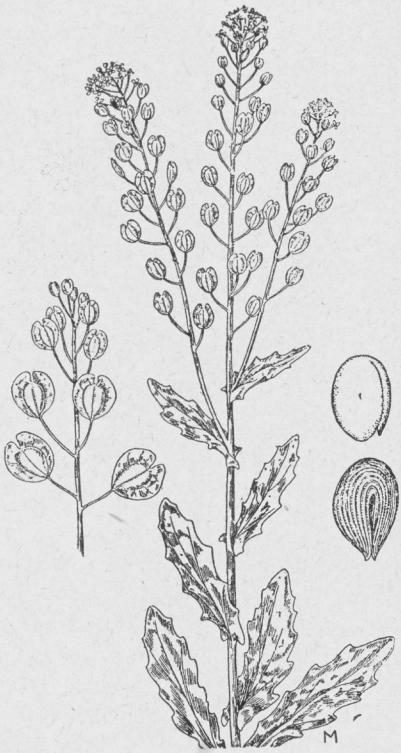

Fig. 27. Penny-cress.

Marsh Cress *(Rorippa islandica var. microcarpa)* *(Rorippa islandica var. hispida)* *(Radicula palustris* of Manuals)

This weed is a member of the mustard family. It behaves primarily as a winter annual, but also as an annual, biennial or perennial. It is most destructive in small grain fields, especially in low or poorly drained areas. Heavy rainfall in the autumn months seems to encourage seed germination, and the young plants are then able to live through the winter. Disking in the spring, especially in wet land, will not destroy the well-rooted plants which grow more rapidly than spring-seeded small grain, so that the marsh cress usually chokes out the grain. The plants are somewhat bushy when mature; they have yellow flowers, lobed leaves and short seed pods. (See fig. 28.) The seeds are so small that one cannot see them distinctly without a hand lens. The use of clean seed and spring plowing of infested areas are recommended control measures. Wet land should not be planted to small grain but to soybeans, corn, or some other cultivated crop.

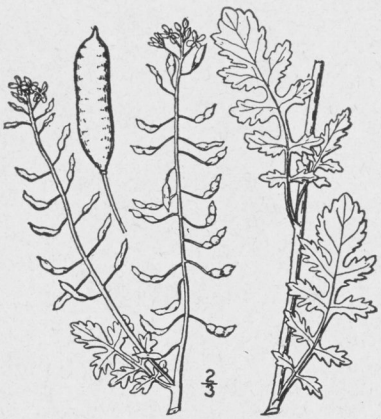

Fig. 28. Marsh cress.

Yellow Rocket *(Barbarea vulgaris)*

Yellow rocket or winter cress is an early blooming perennial, or biennial, of the mustard family. It has a straight tap root with a crown from which new shoots arise each spring. The lower leaves are dark green, notched and about 6 inches long. Stalks are produced early with a mass of yellow flowers. (See fig. 29.) This plant grows in pastures, meadows and along roadsides in southern Iowa and is becoming scattered in northeastern Iowa. Yellow rocket will not withstand clean cultivation, but in pastures and meadows it should be cut or dug to prevent seed production.

Fig. 29. Yellow rocket.

Rough Cinquefoil *(Potentilla monspeliensis)*

This plant (fig. 30), a member of the rose family, behaves either as an annual or biennial, reproducing only by seeds which are borne in enormous numbers. The stems of this plant are erect, rough, hairy, somewhat branched and 1-2 feet high. The leaves are alternate, borne in groups of three, and resemble those of our cultivated strawberry to which this plant is related. The flowers also resemble those of the strawberry except that they are smaller in size and yellow in color.

This plant, growing in such enormous numbers that it completely crowds out stands of small grain, usually is much more serious in seasons when a wet fall is followed by a wet spring. Fall rains enable the seeds of this plant to germinate and the young seedlings to establish themselves. They pass the winter as young, well-developed plants. If spring rains prevent thorough preparation of the ground for the seeding of small grain, or if the disking and harrowing operations during the seeding season are done on damp days or on wet soil, enormous numbers of these plants survive and their resultant fast growth very often completely crowds out small grain.

Fig. 30. Rough cinquefoil.

Areas that are known to be heavily infested with this weed should, insofar as is possible, be spring plowed and put into clean-cultivated crops. When it is necessary to put small grain on such heavily infested areas, it is highly advisable that before the crop is seeded extremely thorough cultivation be practiced, preferably on warm, dry, windy days.

Wild Rose *(Rosa spp.)*

One or more species of wild rose occurs in Iowa, and in the northern half of the state this plant is becoming a problem in cultivated fields. It grows in alfalfa fields, pastures, small grain fields and along roadsides. The rootstocks are long, tough and perennial and they repeatedly send up new plants. The flowers are white, pink or rose and are followed by reddish fruits which are nearly filled with seed. (See fig. 31.) Use a spring tooth harrow or smother crops to control it.

Fig. 31. Wild rose.

Wild Licorice *(Glycyrrhiza lepidota)*

Wild licorice is a member of the legume family. It is a perennial with tough, woody, creeping rootstocks. It may be found in lawns, dooryards, fencerows, pastures and cultivated fields. It has compound leaves with many leaflets arranged in pairs on opposite sides of the leaf axis. The flowers are produced terminally in a spike and are purple. The fruit is a small bur, resembling a cocklebur, and is filled with greenish brown seed. (See fig. 32.) Plowing the infested area and planting several successive clean-cultivated crops such as corn or soybeans will control wild licorice. Repeated close mowing or plowing followed by thorough repeated cultivation with a spring tooth harrow is also effective.

Poison Ivy (*Rhus radicans*) (*Rhus toxicodendron* in part)

This plant, also called three-leaved ivy or poison creeper, is a perennial that every year causes serious discomfort to thousands of people in all walks of life. It is a cosmopolitan plant, always occurring where least expected. It is not an outstanding plant and is often discovered only after contact with it has produced serious results. All parts of the plant, even the roots, are poisonous to the skin of susceptible persons. The plant is poisonous throughout the entire year. This is a plant with which every person should be thoroughly familiar. (See fig. 33.)

Poison ivy exhibits great diversity of form. Some plants are bushy, others shrubby or even climbing. Some leaves are smooth, others are crinkled and have smooth, serrate or even indented margins. These variable characteristics have led botanists to

Fig. 32. Wild licorice.

classify this plant into several forms. Since all forms are poisonous to many people only a general discussion is in order here.

The plant is widespread and found primarily in waste places, fencerows, dry rocky fields, timberland, parks, cemeteries, preserves, alluvial woodlands, roadsides and railroad right-of-ways. It is likely to be found in any area except heavily grazed pastures, closely clipped lawns or areas that are in any type of cultivated crop. The stems of the plant usually are woody and it may appear as a small shrubby plant or as a vine climbing

Fig. 33. Poison ivy.

by aerial rootlets on fences, walls and trees. The plants produce slender, creeping rootstocks, which ramify the soil for several yards from the parent plant, sending up short, slender, leafy shoots from their joints (nodes). The leaves are alternate on the stem, always borne in groups of three leaflets. These leaflets may be glossy or dull green, usually smooth but occasionally somewhat hairy. Some leaf edges are smooth, others are toothed or even somewhat lobed. The yellowish green flowers usually are borne in June or July. The fruit is a small white or cream-colored waxy drupe.

Contact with this plant causes inflammation and swelling accompanied by painful irritation of the skin of susceptible persons. Many persons claim immunity to the action of this plant, but it is a good precautionary measure for everyone to avoid the plant as far as possible. When eradication measures are to be undertaken, only persons who are known to be non-susceptible to the action of this plant should be employed.

Poison ivy is readily eradicated in any areas that can be put into clean cultivated or small grain crops for several successive seasons. Any rocky, stony areas or areas inaccessible to cultivating implements may be pastured closely, especially with goats or sheep, over a 2-3 year period in order to eliminate the plant. Poison ivy among valuable trees or shrubbery may be grubbed out or mowed closely several times a year for 2-3 years until no more plants appear. On small areas where it is not necessary to protect valuable shrubbery or trees, chemicals either in the dry or spray form may be used. These are discussed later.

Leaflet P.D.-529 gives additional information on poison ivy. It is available free from the Extension Service, Iowa State College.

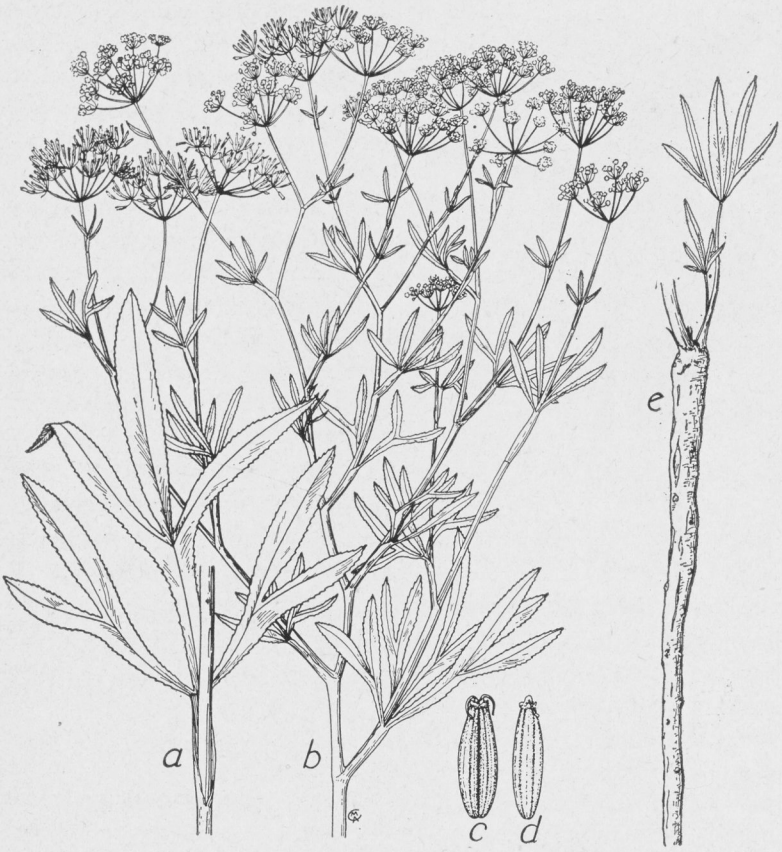

Fig. 34. Sicklewort.

a. Enlarged view of leaves attached to old stem.
b. Mature plant with flowers and fruit.
c. Fruit (two seeds).
d. Individual seed.
e. Portion of old root with young leaves.

Sicklewort *(Falcaria vulgaris)*

This plant is native to Europe but has been found in Adair, Sioux, Plymouth and Clay counties in Iowa. It is a member of the carrot family and a perennial with deep roots which on old plants may be an inch in diameter. Figure 34 shows the characteristic habit of a mature plant and an old root with new plant.

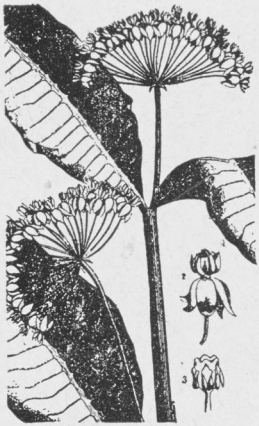

Fig. 35. Common milkweed.

The flowers are borne in umbels followed by an abundance of seed. It is not definitely known how this plant got started in Iowa, but there is considerable evidence that it was introduced upon one farm in vegetable seed purchased from a mail order house. It has proved extremely persistent when once established, spreading from the roots. Farmers should watch closely for it and dig out any plants as soon as discovered. Persistent digging and cutting or applications of sodium chlorate will destroy it.

Common Milkweed *(Asclepias syriaca)*

No perennial field weed is more widely distributed in Iowa than the common milkweed. It occurs in cornfields, small grain fields, waste lots and along roadsides. It has fleshy, creeping rootstocks. Each plant produces several clusters of whitish flowers, some of which develop into large green fruits filled with seed. (See fig. 35.) The most effective control measure is to cut the plants several times each year to prevent top growth and the storage of food reserves. A surface-type cultivator used in corn or soybeans is far superior to a shovel plow. Shovels dodge around the plants without cutting them. Small grain followed by early plowing and summer fallowing, and this in turn followed by a heavy stand of alfalfa, is also a good control method.

Whorled Milkweed *(Asclepias verticillata)*

This plant is widely distributed in Iowa in waste lots, pastures, meadows and along roadsides. It is a perennial with shallow creeping roots. A mature plant grows to a height of about 15 to 18 inches; the leaves are extremely narrow and numerous and the white flowers are borne in clusters in an umbel. The seed pods are long and slender, otherwise typical of those in the milkweed family. (See fig. 36.) A species in the West closely related to this is known to be poisonous to stock, and some authorities claim that the Iowa plant is poisonous. Until proved

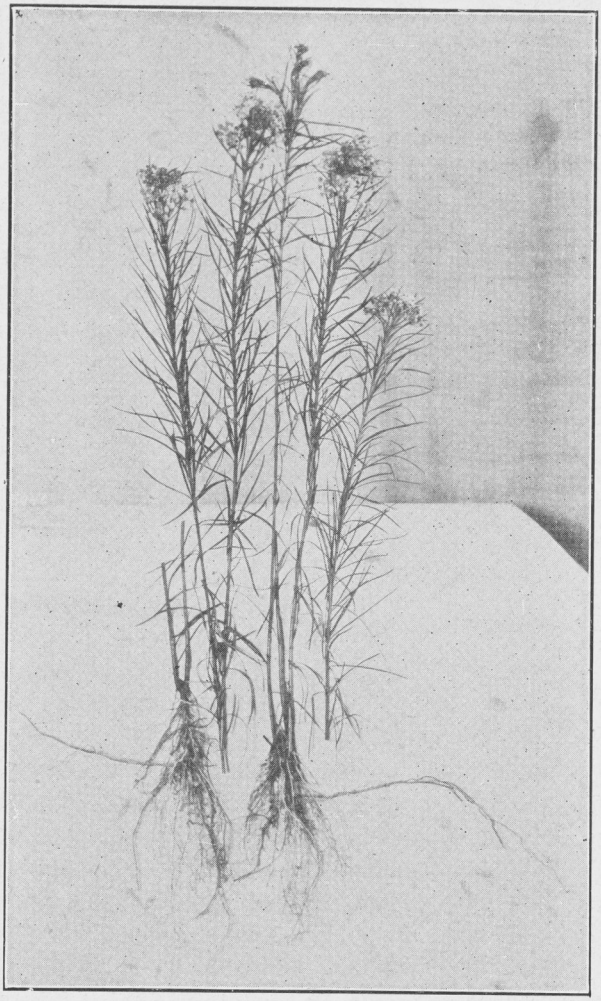

Fig. 36. Whorled milkweed.

harmless it should be regarded with suspicion. Cultivation or frequent mowing will destroy it. Large, heavily infested areas may be controlled by planting clean-cultivated crops like corn or soybeans.

Climbing Milkweed *(Gonolobus laevis)*

Many farmers confuse the climbing milkweed with morning-glory plants because it grows in cornfields, and after corn is

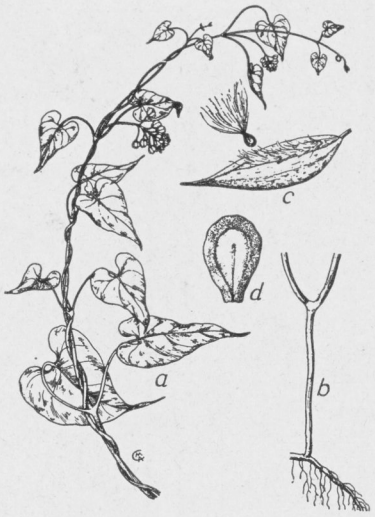

Fig. 37. Climbing milkweed.

a. Plant with leaves and flower dusters.
b. Portion of rootstock with old stem sprout.
c. Fruit with escaping seed.
d. Enlarged view of seed.

laid by the plants entwine themselves around cornstalks. In late summer and early fall, fleshy, smooth green pods are produced which are much like those of the common milkweed. The seeds when mature are discharged and readily scattered by the wind. This milkweed is a perennial with creeping roots. The shape of the leaves and the fruits is shown in fig. 37. Control methods will be found under the discussion on handling perennials on pages 117 to 136.

Annual Morning-Glory *(Ipomoea sp.)*

There are three species of annual morning-glories that have been introduced from tropical America and have escaped from cultivation to become weedy pests. They are as follows:

1. Small Red Morning-Glory *(Ipomoea coccinea)*. This plant has a trailing or twining, smooth, reddish stem. The leaves are alternate, long petioled, entire and smooth. The typical morning-glory-like flower is scarlet; the fruit is a globular capsule and contains four to six brownish black seeds.

2. Ivy-leaved Morning-Glory *(Ipomoea hederacea)*, fig. 38. The stems of this plant are also twining or trailing and possess recurved hairs. The leaves are alternate and simple but are hairy, palmately veined and three-lobed. The flowers are borne on axillary hairy peduncles and have a hairy calyx. They are perfect, regular and showy, morning-glory-like in appearance, white, purple or pale blue in color. The fruit is a globular capsule and contains from four to six somewhat hairy dark brown or black seeds.

3. Purple Morning-Glory *(Ipomoea purpurea)*, fig. 39. This

http://lib.dr.iastate.edu/bulletinp/vol3/iss64/1

plant has hairy, twining or trailing stems. The leaves are alternate, simple, long petioled, entire and pubescent. The flowers are perfect and regular, borne on long axillary peduncles with a bristly hairy calyx. The flowers may be either purple, blue or white in color. The fruit is a globular capsule, four to six-seeded, with brownish black, somewhat pubescent seeds.

Annual morning-glories reproduce only by seed. The prevention of seed production is therefore of prime importance. Small numbers of these plants may be hand pulled or hoed, or intensive clean cultivation may be practiced. For larger areas, two successive seasons of small grain followed by early plowing and summer fallowing will do much to reduce the number of annual morning-glories. Since the seeds of all species of annual morning-glories live in the soil for long periods of time, it is necessary to watch the infested area carefully to prevent re-infestation.

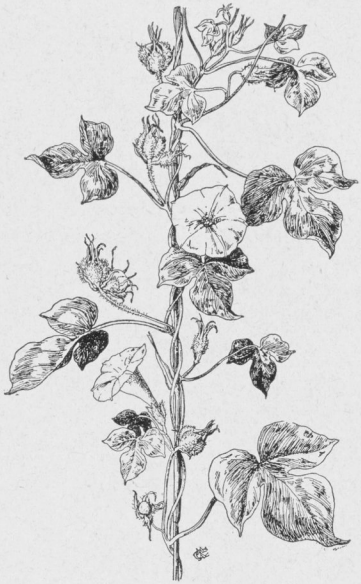

Fig. 38. Ivy-leaved morning-glory.

Wild Morning-Glory
(Convolvulus sepium)

The wild morning-glory or hedge bindweed is a member of the morning-glory family and is often confused with field bind-

Fig. 39. Purple morning-glory.

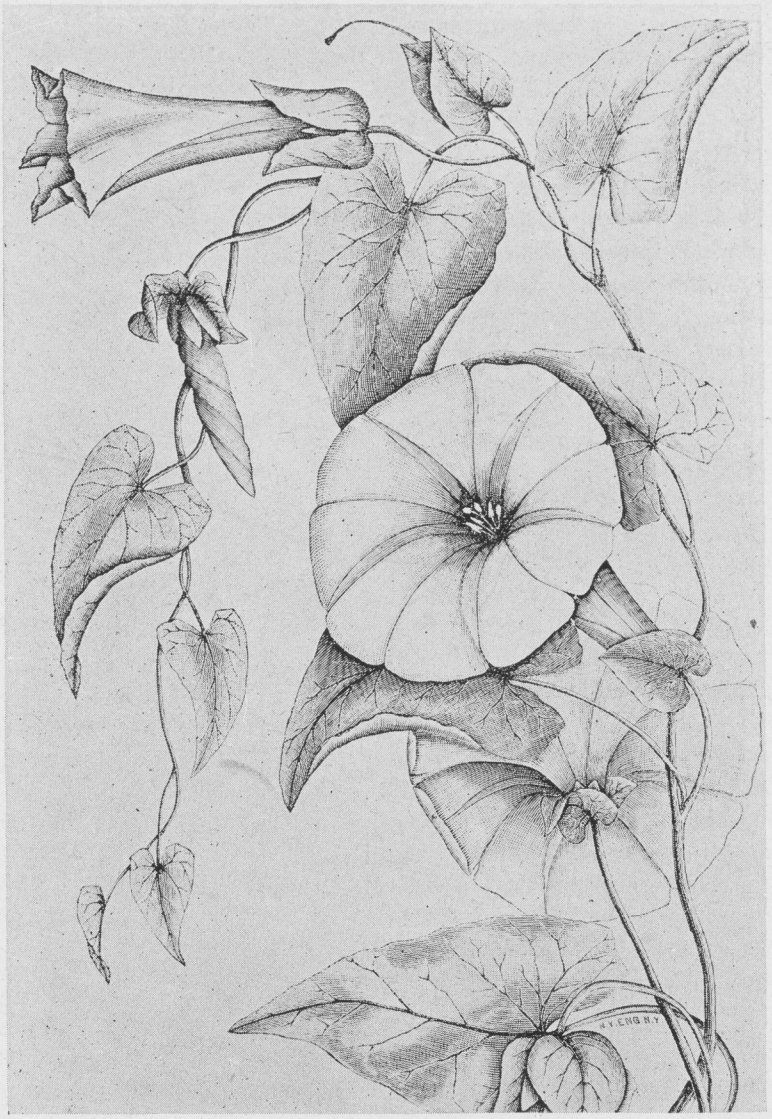

Fig. 40. Wild morning-glory.

weed. It is a perennial with underground, somewhat fleshy rootstocks. The plants climb on upright growing plants, fence posts and wire fences. The leaves are pointed at the tip and

broad at the base like a wedge. The flowers are bell-shaped, 1½ to 2 inches in diameter and white or pinkish. (See fig. 40.) Seeds are frequently produced in fields of small grains and soybeans; hence it is not uncommon to find seeds of the hedge bindweed in threshed lots of soybeans or small grains. In cornfields the bindweed frequently chokes out young plants if proper methods of cultivation are not used. Surface cultivation, pasturing and sowing of alfalfa are effective control measures. (See pages 122 to 136.)

Hoary Vervain *(Verbena stricta)*

This plant (fig. 41) is a perennial and a member of the vervain family. It becomes a weedy pest in mismanaged pastures where overgrazing, drought, soil erosion or lack of fertility gives it a chance to become established. It is a native in this region. It does not spread by underground roots but lives over from year to year by means of the old crowns.

Fig. 41. Hoary vervain.

The stems of this plant are erect, simple, have only a few branches and attain a height of 1-2½ feet. The leaves are opposite and simple, oblong, doubly serrate and sessile on the stem. Both stem and leaves are covered with fine whitish hairs. The blue or purplish flowers are borne in dense spikes at the tips of the branches.

Scattered plants in small areas should be grubbed or pulled out before seed is produced. For larger areas, clean-cultivated crops are the best method of control. In areas where topographic conditions prevent plowing and cultivated crops, the adoption of a pasture improvement program involving the application of lime, manure and phosphates coupled with reseeding to legumes,

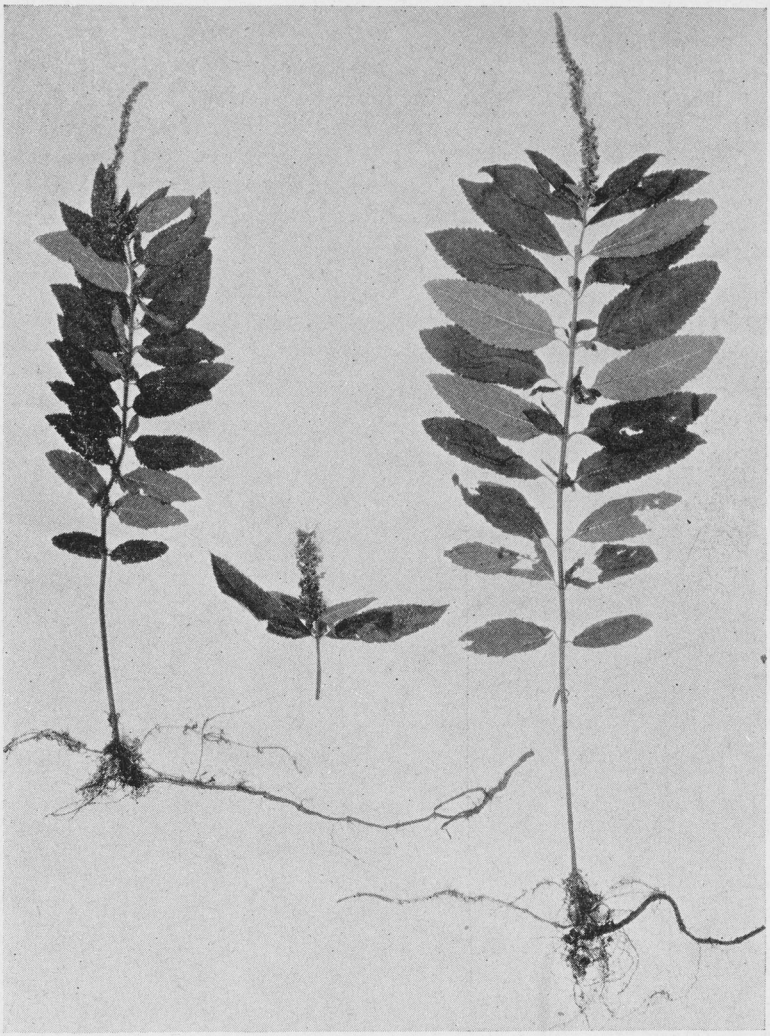

Fig. 42. Germander.

the prevention of overgrazing and the liberal use of the mower to prevent seed production will gradually drive out this pest. Further information on pasture improvement may be obtained from the Agronomy Department at Iowa State College.

White vervain *(Verbena urticifolia)* and blue vervain *(Verbena hastata)* are closely related to the above plant, occur in similar habitats and are controlled the same way.

Germander *(Teucrium canadense)*

Germander is one of the few members of the mint family which are a frequent problem in cornfields. This weed is a perennial with shallow creeping rootstocks. At maturity the plants are often 18 inches to 2 feet high and the stems are square; leaves are numerous and the flowers pale pink. (See fig. 42.) An abundance of seed is produced in cornfields after cultivation has ceased. Surface cultivation is the most effective control measure. Small grain for 2 years followed in each case by early plowing and repeated, thorough, summer fallowing has also proved an effective control measure.

Motherwort *(Leonorus cardiaca)*

Motherwort is a member of the mint family. It is a perennial with short creeping rootstocks, a square upright stem with broad, five-pointed leaves and purple flowers which are borne in dense clusters in the leaf axils. (See fig. 43.) When ripe the fruit clusters are somewhat bur-like with sharp-pointed calyx teeth. Each individual flower develops four seeds or nutlets. This weed grows abundantly in groves and other uncultivated places. Frequent mowing to prevent seed production will destroy it. Any type of clean-cultivated crop will also control it.

Buffalo Bur *(Solanum rostratum)*

The buffalo bur is an annual weed that belongs in the nightshade family. It was probably introduced into Iowa in commercial chicken feed. The stems, leaves and seed pods have numerous stiff yellow spines. The leaves are shaped like those of watermelon plants. (See fig. 44.) Each seed pod or bur is filled with many black seeds. The most important methods of control are to cut, pull or hoe all plants before they blossom, and avoid the use of commercial feeds and seeds which carry seed of this weed.

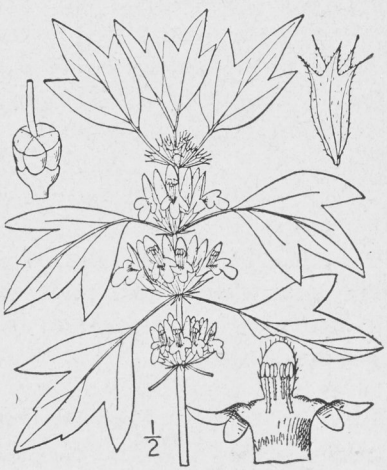

Fig. 43. Motherwort.

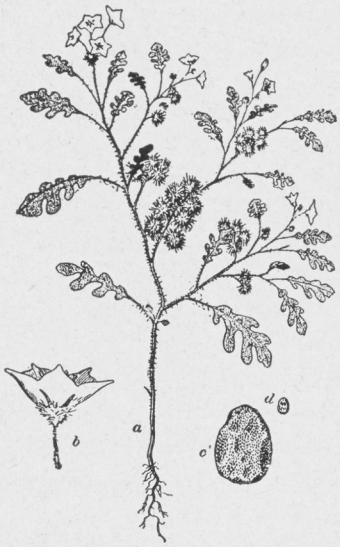

Fig. 44. Buffalo bur.

Fig. 45. Mullein.

Mullein *(Verbascum thapsus)*

This plant (fig. 45) is a biennial of the figwort family. It reproduces only by seed. It is widespread in the United States and southern Canada where it occurs in pastures, meadows, old fields and waste places, usually on gravelly or stony soils.

The stems of this plant are erect and stout. The entire plants, especially the basal tufted leaves, are densely woolly. The perfect yellow flowers are borne in long, dense, terminal cylindrical spikes. The seeds are borne in capsules in enormous numbers. The plant is commonly known and further description is unnecessary.

Close mowing to prevent all seed production will help control this weed. Hoeing or spudding out the rosettes below the crowns in autumn or early spring is also an effective means of control. Large, heavily infested fields should be plowed, fertilized and planted to several successive clean-cultivated crops before the area is reseeded.

Tarweed *(Grindelia squarrosa)*

Other names given to tarweed are rosinweed and gumweed. The plant is a biennial or perennial of the sunflower family. It

grows in pastures, along roadsides and occasionally in alfalfa fields and meadows in western and northwestern Iowa. The yellow blossoms appear in August, and at that time the leaves and stems are covered with a resinous, sticky substance like pitch. (See fig. 46.) Frequent mowing to prevent seed production and the use of clean seed are effective control measures. Any type of clean-cultivated crop will also control it.

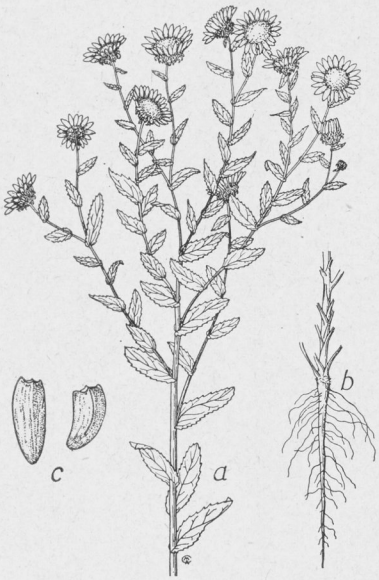

Fig. 46. Tarweed.

a. Mature plant in flower.
b. Root with old stem.
c. Seeds.

Daisy Fleabane *(Erigeron annuus)*

This annual (sometimes biennial) of the Composite family occurs in meadows, pastures and waste places. It is native in Iowa and especially common in southern and eastern Iowa. The stems of this plant attain a height of 2-3 feet. The thin glabrous leaves are alternate on the stem. The flowers are borne in clusters at the top of the plant, have white petals and a yellow center. Seed is produced in enormous numbers. The plant is illustrated in fig. 47.

The easiest method of controlling this weed is to plow up the infestations and plant clean-cultivated crops for 2-3 years before the area is reseeded. Very often this method cannot be used

Fig. 47. Daisy fleabane.

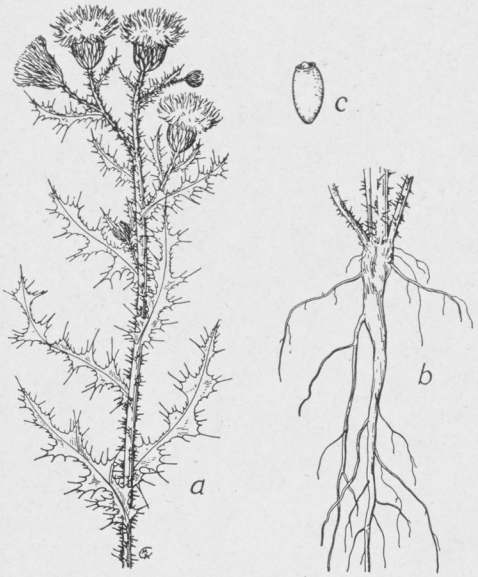

Fig. 48. Curled thistle.
a. Mature plant in flower.
b. Root.
c. Seed.

because of the contour of the land. On extremely rolling pasture and meadow land, a good soil improvement program involving the use of lime, fertilizers and reseeding to legumes should be undertaken. More information on pasture and soil improvement programs may be secured from the Agronomy Department at Iowa State College.

Curled Thistle *(Carduus acanthoides)*

The curled thistle is a close relative of the Canada thistle, but it is a biennial, not a perennial. This weed is confined primarily to southwestern Iowa but is found occasionally in other parts of the state. Mature plants range from 1 to 3 feet high; the stems are much branched and densely spined. The leaf bases extend downward on the stem, and the leaf margins are spiny. The heads occur several to each branch, in clusters, and the flowers are rose-purple. (See fig. 48.) Curled thistle grows in pastures, meadows and waste places. The most effective control measures are either to dig out the individual plants with a spade or cut them to prevent seed production. Curled thistle is a comparatively new weed in the state. Farmers are warned to watch for it and eradicate it as soon as discovered.

Scabious Knapweed *(Centaurea scabiosa)*

This weed is a close relative of the Russian knapweed. (See fig. 49.) It has a perennial tap root with no creeping rootstocks.

The stem is hairy, simple or branched, growing to a height of 2 or 3 feet. The lower leaves are lobed and long petioled, the upper sessile and entire. The heads are solitary on the branches, 2 inches in diameter and purple. An abundance of seed is produced which usually shatters to the ground near the parent plant. This knapweed has been found in Hardin and Mills counties and probably occurs in northwestern Iowa, for it has been found on the west side of the Big Sioux River near Hawarden. Individual plants should be pulled or dug and large areas mowed frequently to prevent seed production. Small grain, followed by early plowing and thorough summer fallowing, and this in turn followed by heavy smother crops or clean-cultivated crops will control this weed. Scabious knapweed is a relatively new weed in the state.

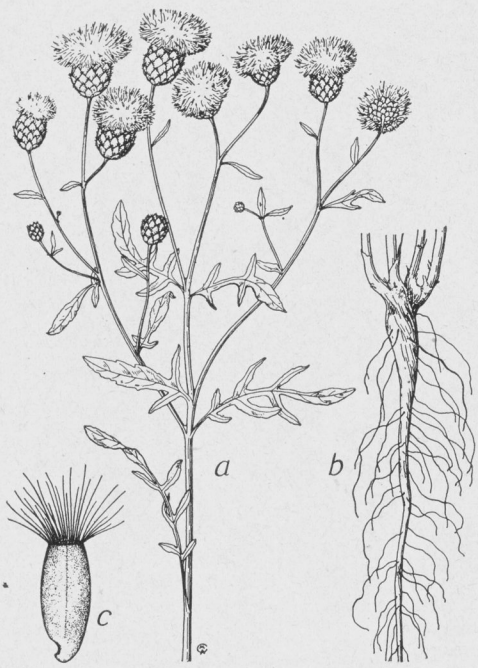

Fig. 49. Knapweed.

a. Mature plant in flower.
b. Root with attached stems.
c. Seed.

Spotted Knapweed *(Centaurea maculosa)*

The spotted knapweed is more widely distributed in Iowa than the scabious knapweed, having been found in Lyon, O'Brien, Hamilton, Hardin, Sioux and Kossuth counties. It is an annual or biennial, growing 2 to 3 feet high with densely hairy branches and stem. The leaves are small, fine and deeply cut into five segments. The heads are small, resembling those of the bach-

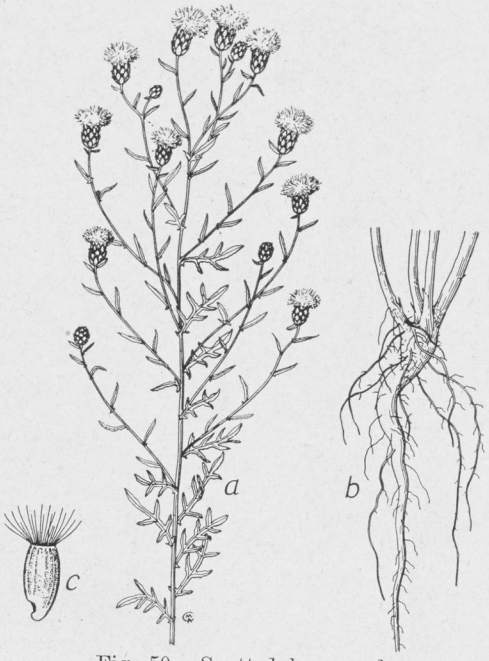

Fig. 50. Spotted knapweed.
a. Mature plant in flower.
b. Root with old stems.
c. Seed.

elor's button, and the blossoms are purple or whitish in color. (See fig. 50.) An abundance of seed is produced by this weed if it is not cut. It grows in pastures, meadows and along roadsides. Control measures are the same as for the scabious knapweed.

Chicory *(Cichorium intybus)*

Chicory is a perennial weed of the sunflower family. It has a tap root with a crown from which new shoots arise each year. The plants blossom continuously from July to late fall, producing pale blue flowers followed by an abundance of seed which soon shatters to the ground. (See fig. 51.) Chicory commonly occurs along roadsides and occasionally in pastures and alfalfa fields. The root when dried is often ground and used as a substitute for coffee in France and in some of the southern states. Control is accomplished by sowing clean seed and by pulling the plants before blossoming time when the ground is loose. Large, heavily infested areas should be plowed and planted to clean-cultivated crops like corn or soybeans.

Goat's Beard *(Tragopogon pratensis)*

Wild salsify is one of the names given to goat's beard. It is a member of the sunflower family and a biennial with a tap root like the dandelion. Occasionally it behaves as a perennial. The

Fig. 51. Chicory. (After Clark and Fletcher.)

flowers are large, pale yellow, and the mature heads form a large ball about twice the size of the mature dandelion head. (See

Fig. 52. Goat's beard.

fig. 52.) This weed grows along roadsides, in waste lots and occasionally in meadows. The roots must be pulled out in order to destroy the plants. Pulling and burning is by far the best method of control if the number of plants involved is small. For large, heavily infested areas heavy pasturing or plowing followed by clean-cultivated crops such as corn or soybeans is the best method of control.

Wild Lettuce *(Lactuca serriola)* *(L. scariola* and *L. scariola var. integrata* of Manuals)

Prickly or wild lettuce is a winter annual of the sunflower family and is found throughout the state in meadows, waste places and along roadsides. Seeds germinate in late summer and produce a rosette of leaves which resembles that of the dandelion. Growth starts from the crown of the root early the following spring, resulting in a tall plant with a stiff, coarse stem branched at the top. The blossoms are numerous, pale yellow, and are about ½ inch in diameter. The lower leaves are notched and lobed, the upper, frequently entire. Both types have stiff spines on the lower side of the leaf midrib. (See fig. 53.) Seeds are produced in June in great abundance and are widely distributed by the wind. Wild lettuce will not withstand cultivation, but more than one cutting is required to prevent seed production. Plowing followed by clean-cultivated crops such as corn or soybeans will control it readily.

PRINCIPLES AND METHODS OF WEED CONTROL

Effective control of weeds is based on certain fundamental principles and on the application of these principles in control

methods. These principles are as follows:

(1) Sow clean seed of strong vitality.

(2) Prevent weed seed production.

(3) Encourage germination of weed seed and kill the seedlings.

(4) Prevent storage of organic food reserves in the roots of perennials.

(5) Harrow and burn rootstocks of shallow-rooted perennials.

(6) Maintain or increase soil fertility.

(7) Watch for new weeds, study their habits, get them identified at once by sending them to your county extension director, or to the Extension Service at Iowa State College. Start eradication measures immediately.

(8) Utilize your county extension director and county weed commissioner to help you work out feasible, effective methods of control.

Fig. 53. Wild lettuce.

In general, weeds may be successfully controlled by applying the principles outlined above. Most weeds, annuals, winter annuals, biennials or perennials may be controlled by practicing good farming methods. Good farming methods which may be successfully employed should include: (1) Producing, buying and sowing clean seed, (2) mowing roadsides and pastures two to three times a year to prevent weed seed production, (3) encouraging weed seed germination and destroying weeds in seedling stage by frequent harrowing before and after a crop is planted, (4) adopting a soil-building program, (5) rotating pastures and preventing overgrazing to control pasture weeds, (6)

plowing early to prevent weed seed production, (7) utilizing a crop rotation system detrimental to the life cycle of the weed, which might involve plowing and clean-cultivating crops such as corn, soybeans, sugar beets or potatoes, followed by legumes or grasses for hay or pasture, (8) using special methods for perennials and (9) using weed-killing chemicals for small areas. A brief discussion of some of these common methods of weed control follows.

PRODUCE, BUY AND SOW CLEAN SEED

The primary cause of the weed problem in Iowa is the presence of weed seed in agricultural seed that is sown on the land. A few seeds of a noxious weed may produce enough plants to start a center of distribution either by means of seed harvested in grain, clover and grass seed, or by the agencies of wind, water and animals. As long as seed companies are allowed to sell impure seed, and farmers produce poor seed and continue to sow it, new weeds will be introduced, local weeds will be more widely scattered and the weed problem will increase in severity.

The weed seeds that are commonly carried in agricultural seed are shown in table 4.

The presence of weed seed in crop seed has been determined over a period of years by the Botany and Plant Pathology Section of the Iowa Agricultural Experiment Station, Ames, Iowa. During the years 1913 to 1921, it was found that 227 different species of plant seeds occurred as impurities in the samples

TABLE 3. THE NUMBER OF WEEDS THAT MAY BE INTRODUCED INTO AGRICULTURAL LAND BY SOWING IMPURE CROP SEED.

Crop seed	No. of weed seeds per 5 grams	No. of weed seeds per lb. of crop seed	Seeding rate of crop seed per acre in lbs.	Possible no. of weeds per:	
				Acre	Square foot
Alsike clover	50	4500	5	22,500	1.9
Timothy	50	4500	5	22,500	1.9
Red clover	20	1800	10	18,000	3.0
Sweet clover	20	1800	15	27,000	1.6
Alfalfa	20	1800	15	27,000	1.6
Barley	5	450	96	43,200	1.01
Oats	5	450	96	43,200	1.01
Wheat	5	450	90	40,500	1.07

TABLE 4. LIST OF CROP SEEDS USED IN IOWA SHOWING MOST PREVALENT WEED SEEDS.

Weeds	Crops										
	Oats & other grains	Red clover	Sweet clover	Alfalfa	Timothy	Alsike clover	Blue-grass	Brome grass	Soy-bean	Flax	Hemp
Barnyard grass	x	x	x	x	..	..	x	x	x	x	..
Black-seeded plantain	..	x	x	x	x	x	x	..	..	x	..
Bracted plantain	..	x	x	x	x	x	x	..	..	..	..
Buckhorn	..	x	..	..	x	x	x	..	..	..	..
Butterprint	x	..	..	..	..	..	..	..	x	x	x
Canada thistle	x	x	x	x	x	x	..	x	..	x	..
Catchfly	..	x	..	..	x	x	x	..	..	..	..
Cocklebur	..	..	..	..	..	..	..	..	x	..	..
Crabgrass	x	x	x	x	x	x	x	x	..	x	..
Dodder	..	x	x	x	..	x	..	..	..	x	..
Dog fennel	..	x	x	x	x	x	x	..	..	..	..
Downy brome grass	..	..	..	..	..	..	..	x	..	..	..
Dragonhead	..	..	x	..	..	..	..	..	..	..	..
False flax	..	..	..	..	..	..	..	..	..	x	..
False strawberry	x	x	..	..	x	x	x	..	..	..	..
Field bindweed	x	..	..	..	..	..	..	x	x	x	x
Foxtail	x	x	x	x	x	x	x	x	x	x	x
Horse nettle	x	x	x	..	..	..	..	..	x	..	..
Japanese brome grass	..	..	..	..	..	..	..	x	..	..	..
Kochia	..	..	..	x	..	..	..	..	..	..	..
Lambsquarters	x	x	x	x	x	x	x	x	..	x	..
Marsh cress	x	..	..	..	..	..	..	..	..	..	..
Ox-eye daisy*	..	..	..	..	..	..	x	..	..	..	..
Peppergrass (common)	..	..	..	..	..	..	..	..	..	..	..
Peppergrass (perennial)	x	..	..	x	..	..	..	..	..	..	..
Pigweed	x	x	x	x	x	x	x	x	..	x	x
Quack grass	x	x	..	x	..	x	..	x	..	x	..
Ragweed	x	x	x	x	x	..	..	x	x	x	x
Russian pigweed	..	..	..	x	..	..	..	..	..	..	..
Russian thistle	..	x	x	x	..	..	..	..	..	..	..
Sheep sorrel	..	x	..	x	x	x	x	..	..	..	..
Shepherd's purse	x	x	..	..	x	x	x	..	..	..	..
Sour dock	x	x	x	x	x	x	x	x	x	x	x
Wild buckwheat	x	x	x	..	..	..	..	x	x	x	x
Wild morning-glory	x	..	..	..	..	..	..	..	x	..	x
Wild mustard	x	x	x	x	..	x	..	x	x	x	..
Wild rose	x	..	..	..	..	..	..	..	..	..	..

*Common in redtop.

tested. Most of the impurities were weed seed. Canada thistle seeds were found in 50 samples of red clover, 4 of alfalfa, 50 of alsike, 6 of sweet clover, 7 of timothy and 37 of timothy and clover mixtures. Canada thistle seeds were found in 2 percent of the number of samples tested. Quack grass seeds occurred in 1.2 percent of the samples tested.

Further evidence regarding the dissemination of weed seed by the agency of crop seed was obtained in tests carried on from July, 1929, to June, 1930. It was found that foxtail occurred in 564 samples of red clover, 128 samples of sweet clover and 129 samples of alfalfa. Sour dock was found in 138 samples of red clover, 20 samples of sweet clover, 17 samples of alsike, 29 samples of alfalfa. Smartweed was found in 183 samples of red

clover, 22 of sweet clover, 16 of alfalfa. These records show that more attention should be given by farmers to the kind of seed sown in order to prevent the initial spread of weeds.

Farmers who harvest fields foul with weeds for seed purposes and expect to sell such seed to the trade are not helping to solve the weed problem. Good seed may be produced by: (1) Sowing clean seed on clean land for the production of a seed crop and (2) destroying or cutting the areas in a field infested with bad weeds before the remainder of the field is cut for seed. All seed dealers prefer to buy seed free from weeds and can afford to pay more for good than for low-quality seed.

Other methods that may be used in obtaining clean seed are: (1) Clean and test all seed before sowing and (2) buy good seed either from certified seed growers' associations or from reliable seed dealers. Few farmers have the proper equipment for cleaning seed of alfalfa, clovers and grasses. It is best, therefore, to have them cleaned by seed houses or elevators before sale or sell the supply for recleaning.

The increased interest in seed cleaning in Iowa has resulted in the establishment of numerous seed cleaning centers throughout the state. These central cleaning stations possess adequate equipment to clean most types of common agricultural seed. The recently enacted Iowa seed law prohibits the sale of any agricultural seed intended for seeding purposes that contains seed of the primary noxious weeds or a total of more than 3 percent weed seeds. This statute has already been a stimulus to the production and buying of better seed and to an increase in the number of custom cleaning centers in Iowa. Many lots of seed that are illegal to sell because of the presence of weed seeds can be made salable by cleaning. The continued growth and increasing operation facilities of such cleaning centers will certainly be a tremendous factor that will help reduce our weed problem in the future. The producing, cleaning, buying and sowing of clean, viable seed certainly is the first line of defense against an ever-increasing weed menace.

The Iowa State College Seed Laboratory is equipped to make purity and germination tests of all kinds of seed. A purity test will give information as to the kinds of crop seeds and weed seeds in a sample. Noxious weed seeds if present to any extent

can be detected by an examination of a representative sample.

The Iowa seed law makes it unlawful for any citizen of the state to sell seed without a label or at least a posted or written statement concerning the quality of the seed being offered for sale. A farmer who sells seed on his own farm is required to either display a placard or supply a written or printed statement to the purchaser with the following information:

a. The percentage germination of the seed being sold together with the calendar month and year said seed was tested to determine the percentage.

b. The kind and number per ounce or pound of all secondary noxious weed seeds in the lot, if in excess of the amounts stated in the law.

c. A guarantee that no primary noxious weed seeds are present.

The charge for a test on seed is usually 50 cents which should be sent with the sample. Coins should not be sent and if a check is enclosed an exchange charge of 5 cents should be added. Elevators, farm bureaus, or other farm agencies and organizations may send seed direct to the laboratory for test.

MOW ROADSIDES AND PASTURES TO PREVENT WEED SEED PRODUCTION

A number of the noxious weeds as well as many others grow readily along the roadside, in fencerows and in waste lots. It is not uncommon for fields adjoining the public highways to become infested with bad weeds either by wind-blown seed or by creeping roots. Flowering dates of roadside weeds extend over a long period of time. Sour dock, red sorrel and squirrel-tail develop seed early, whereas Russian thistle and wild sunflower bloom late in the season. If roadsides are mowed once the last week in May or the first of June, a second time in July and a third time in August or September, no weeds should mature seed, and in the course of a few years bluegrass will be the predominant cover unless such other perennials as quack grass or Canada thistles have established themselves. Roadsides that are fairly level and have sufficient lime in the soil can be seeded to alfalfa, a crop which will remain established for several years. It will prevent the growth of weeds and furnish two or three crops of hay each year.

Ragweed, goldenrod, ironweed, beggars' lice, downy brome grass, bull thistle, vervain, whorled milkweed and many other pasture weeds may be kept down by frequent mowing. Such repeated mowing coupled with the prevention of overgrazing and the adoption of a good pasture improvement program involving the use of lime, phosphates and reseeding to legumes will do much toward improving the quality of Iowa pastures. Further information on pasture improvement may be secured from the Agronomy Department at Iowa State College.

ENCOURAGE WEED SEED GERMINATION AND DESTROY WEEDS IN SEEDLING STAGE

When weeds, the seeds of which live in the soil for many years, are found growing in a field it is folly to plow the mature seed under and then depend on ordinary methods of farming to eradicate them. Sour dock, mustard, butterprint, shoofly, pigweed, smartweed and other plants listed in table 5 have seeds which retain their vitality in the soil for long periods of time.

TABLE 5. VITALITY OF WEED SEEDS IN THE SOIL.

Common name	Scientific name	Known years of life
Black mustard	*Brassica nigra*	50 or more
Black nightshade	*Solanum nigrum*	20 or more
Blue vervain	*Verbena hastata*	20 or more
Bristly foxtail	*Setaria verticillata*	20 or more
Button weed	*Abutilon theophrasti*	20 or more
Canada thistle	*Cirsium arvense*	20 or more
Cinquefoil, five-finger	*Potentilla monspeliensis*	20 or more
Common chickweed	*Alsine media*	30
Common mullein	*Verbascum thapsus*	35
Common plantain	*Plantago major*	40 or more
Curled or sour dock	*Rumex crispus*	40 or more
Dodder	*Cuscuta polygonorum*	20 or more
Dog fennel	*Anthemis cotula*	25
Evening primrose	*Oenothera biennis*	50 or more
Green foxtail	*Chaetochloa viridis*	20 or more
Hedge bindweed	*Convolvulus sepium*	20 or more
Horse nettle	*Solanum carolinense*	11 or more
Jimson weed	*Datura stramonium*	20 or more
Mullein	*Verbascum blattaria*	50 or more
Lambsquarters	*Chenopodium album*	40
Penny-cress	*Thlaspi arvense*	20 or more
Peppergrass	*Lepidium virginicum*	40 or more
Pigweed	*Amaranthus retroflexus*	40 or more
Purslane	*Portulaca oleracea*	50 or more
Quack grass	*Agropyron repens*	4
Ragweed	*Ambrosia artemisiifolia*	40 or more
Rugel's plantain	*Plantago rugellii*	20 or more
Smartweed	*Polygonum persicaria*	20 or more
Shepherd's purse	*Capsella bursa-pastoris*	35
Shoofly	*Hibiscus trionum*	20 or more
Tumble weed	*Amaranthus graecizans*	40
Water pepper	*Polygonum hydropiper*	50 or more
Yellow foxtail	*Chaetochloa glauca*	30 or more
Yellow nutgrass	*Cyperus esculentus*	20 or more

In any such case the most important thing to do is to encourage the germination of the weed seeds and kill them before top growth is produced. This can be done by disking and harrowing the plowed land early in the spring or by plowing cornstalk ground early in the spring just before time to plant corn. If the former method is followed a good seedbed should be prepared and then the land can be worked with a harrow or weeder at intervals of 5 to 7 days to drag the germinating seeds to the top of the soil where they will be killed. This practice can be used with the production of a soybean crop, because beans can be planted as late as the middle of June (if an early variety is used), thus allowing time for the germination of weed seeds. In addition the crop can be cultivated until late in the season. Sorghum may be used as a substitute for soybeans. Cultivating until August followed by seeding to alfalfa is also a valuable method.

In cornfields it is often unwise to cultivate deep after the seedbed is prepared because more weed seeds are dragged to the surface to grow in late summer and fall. Soils which are in good physical condition should be cultivated close to the surface as long as possible after the crop is planted with a weeder or rotary hoe, followed later by shallow cultivation using a cultivator equipped with surface sweeps or blades to cut off the perennial weeds.

ADOPT A SOIL-BUILDING PROGRAM

Certain weeds are able to thrive in worn-out soils and crowd out less peristent crop plants. Sheep sorrel, buckhorn, bracted plaintain, dandelion, vervain, ironweed and many others persist in meadows, pastures, lawns and to some extent in cultivated fields low in fertility, to the exclusion of hay and pasture crops. The character of the weed population in pastures and meadows usually gives some indication of the care that the land has received.

The first step in the control of weeds in worn-out soils is to replenish the fertility. This can be accomplished mainly in two ways: (1) By applying barnyard manure and (2) by growing green manure crops. Permanent pasture land can be greatly benefited by applying manure which will increase the humus content and moisture-holding capacity of the soil, provide food

materials for the pasture crops and enable them to compete more successfully with the weeds. It is a good practice for farmers to use green manure crops to supply humus and nitrogen to their field soils and divert the manure to permanent pastures and meadows. Meadows and pastures that are low in fertility but are to be used for the production of cultivated crops may be limed and seeded to sweet clover with small grains. Later the sweet clover may be plowed under for green manure. Treatment with lime and manure is of special value where sheep sorrel has gained a foothold, because this plant thrives in acid soil. Following the treatment with organic matter one or two crops of corn may be grown, which system, with clean cultivation, will decrease weeds that are troublesome in worn-out soils.

Frequent mowing of pasture land to prevent weed seed production and reseeding are additional methods that help materially in reducing the weed population. In some cases applications of superphosphate are advisable. Further information on soil improvement and reseeding of pastures may be obtained from the Agronomy Department at Iowa State College.

ROTATE PASTURES

It is well recognized that weeds such as ragweed, vervain, beggars' lice, buckhorn, bracted plantain, sheep sorrel, goldenrod, artichoke, bull thistle, whorled milkweed and many others persist in permanent pastures which not only are low in fertility but are overgrazed. Close continuous grazing throughout the season results in a thin, weak grass sod. Under these conditions, weeds crowd in. Grass must be permitted to make a good top growth at some time during the season in order that root reserves may be replenished. Strong roots make possible a thick, vigorous top growth and help crowd out weedy plants. Mowing all pasture weeds will do much toward establishing a better sod of desirable grasses. The repeated judicious use of the mower cannot be overemphasized.

PLOW EARLY TO PREVENT WEED SEED PRODUCTION

There are many annual weeds such as cocklebur, ragweeds, marsh elder, velvetweed, shoofly and sandbur, which mature seeds late in the season. For controlling such weeds it is possible to plant early maturing crops such as small grain, then plow the land immediately after harvest and if necessary, sum-

mer fallow the remainder of the season to prevent all weed seed production. If plowing is impossible, close mowing of the stubble is advisable to prevent weed seed maturation. Fallowing operations to prevent weed seed production can be done either by spike-tooth or spring-tooth harrowing, thorough disking, or surface cultivation. Repeated stirring of the soil will encourage dormant weed seeds to germinate and thus be killed by subsequent cultivations. By following such a procedure, no crops are lost and the land is put into better condition for following crops.

ADJUST CROP SUCCESSION TO CONTROL WEEDS

Certain weeds are very easily controlled if the farmer but adjusts his cropping system so as to take advantage of the weak period in the life history of the weed. Thus wild carrot (biennial) or chicory (perennial), both of which become serious pests in meadows and pastures, can very easily be controlled by plowing and planting several successive clean-cultivated crops. After the weeds are destroyed the area may be reseeded. Similarly marsh cress, penny-cress or downy brome grass (winter annuals) are very easily controlled by spring plowing followed by such clean-cultivated crops as corn or soybeans. Such control measures will yield good results without expending extra-special effort toward weed control. Put early maturing crops on land infested with late maturing weeds. Remove the crop and then prevent weed seed production by early plowing or mowing. Similarly put late planted and late maturing crops on land infested with early maturing weeds. This gives opportunity to kill the troublesome weeds before the main crop is planted. Heavy infestations of such perennials as wild groundcherry, climbing milkweed, or wild morning-glory, can be controlled by planting small grain, followed by early plowing and eventually by alfalfa. Hogs can often be utilized in eradicating wild morning-glory or artichoke, since the animals are fond of the sweet roots and tubers.

USE SPECIAL METHODS FOR PERENNIALS

The ability of certain perennials to take possession of land to the exclusion of a crop under ordinary methods of tillage, makes it necessary to use special methods for their control. For small areas, chemical treatment is most effective, but for large

areas cultural methods are necessary. For the past several years, cooperative experiments have been conducted with farmers who have had large areas of perennial weeds with which to contend. It has been necessary in many cases to depart from the tillage methods commonly used and to devise crop sequences and improved methods of cultivation in order to destroy certain weeds. The most successful methods are described below.

Summer Fallowing

Summer fallowing or "keeping the land black" is an effective method of killing out perennial weeds. In short, it may be said that no green plant can go on living indefinitely without presenting some green leaves to the sun for the purpose of food manufacture. If these tops are destroyed, as is done in summer fallowing, the roots will eventually starve and the plant die. Figure 54 illustrates different types of roots produced by weeds. Summer fallowing, however, is not recommended on areas subject to erosion.

Summer fallowing, to be effective, must be done very systematically, adhering to a strict schedule as closely as climatic conditions permit. Most weeds can be killed by one season of intense summer fallowing, but some of the worst noxious weeds require more than one season to eradicate them completely. Summer fallowing alone, without growing any crop whatever, is recommended only for small areas. It is highly recommended on areas that are just a little too large to warrant the use of chemicals and yet not large enough to justify the use of extensive smother cropping systems. Areas from three-fourths to one and a half acres are usually just a little too large to warrant the use of chemicals and yet not large enough to result in a serious crop loss when fallowed. Summer fallowing in connection with smother crops is the only type of fallowing recommended where the weed infestation is extensive in area. This method will be discussed a little later.

Keeping in mind that dry, hot weather is to be preferred for all fallowing operations, and that the maximum time between cultivations should not exceed 1 week to 10 days, table 6 will serve as a guide where fallowing operations without the use of any smother crops are used.

Fallowing in heavily infested areas must be thorough and

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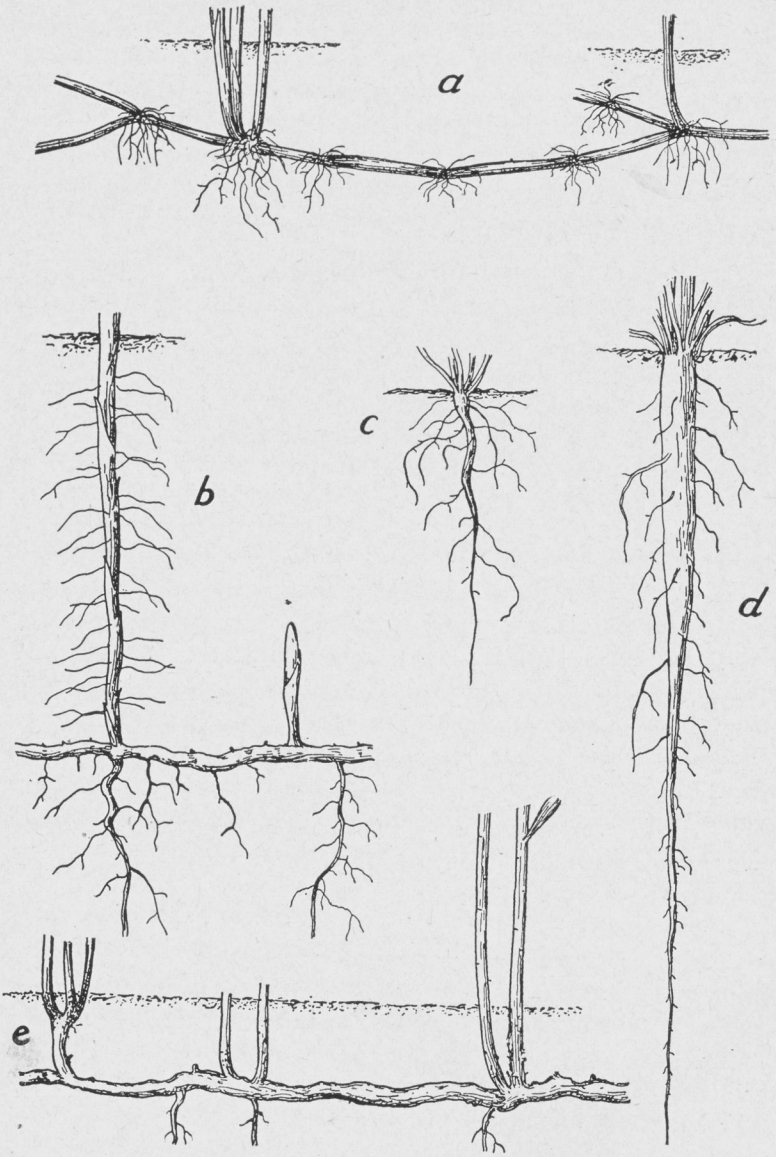

Fig. 54. Underground parts of some weeds.

a. Quack grass.
b. Canada thistle.
c. Buckhorn.
d. Sour dock.
e. Leafy spurge.

TABLE 6. A GUIDE TO FALLOWING OPERATIONS.

Weed	First cultivation		Last cultivation	
	Northern Iowa	Southern Iowa	Northern Iowa	Southern Iowa
Perennial sow thistle	June 15	June 10	Frost	Frost
Canada thistle	June 15	June 10	Frost	Frost
Horse nettle	June 10	June 1	Frost	Frost
Quack grass	June 15	June 10	Frost	Frost
Field bindweed (creeping Jennie)	May 25	May 20	Frost	Frost
Russian knapweed	May 25	May 20	Frost	Frost
Leafy spurge	May 15	May 10	Frost	Frost
Perennial peppergrass	May 20	May 15	Frost	Frost

done often enough to prevent any appreciable growth of the weed in question. Only under such circumstances is it effective. If one or two operations are missed, the weeds are given a new lease on life and consequently the program is set back several weeks. It is easy to see that one or two missed operations will serve to revive the weeds to such an extent that it is hard to tell whether or not any control measures have been undertaken.

The duckfoot type of cultivator shovel (fig. 55) is recommended for fallowing purposes for most of our perennial weeds. For quack grass, devil's shoestring and milkweed, however, the spring-tooth harrow is to be preferred. (See fig. 56.) Heavy infestations of annual weeds such as mustard, penny-cress, velvetweed, shoofly, buffalo bur, foxtail, Russian thistle, wild buckwheat, hemp, ragweed and many others may be materially reduced by summer fallowing. In the case of annuals, repeated harrowings in the spring will serve to destroy thousands of germinating weed seeds.

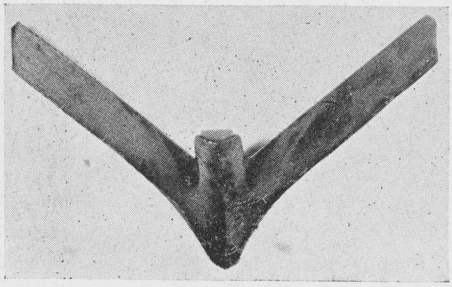

Fig. 55. A duckfoot sweep of value for surface cultivation.

Where extensive weed areas are to be eradicated, it is advisable to combine the use of summer fallowing with some cropping system. In this way the crop grown will at least financially reimburse the individual for his labor and keep the land in a state of tilth, while at the same time killing the weeds. In

Fig. 56. Spring tooth harrow after operation.

fact, it is possible by using recommended cropping practices to kill the weeds and at the same time realize a fair margin of profit.

CROPPING SYSTEMS FOR CONTROLLING PERENNIAL WEEDS

Canada Thistle, Horse Nettle and Perennial Sow Thistle

Alfalfa

The value of a good heavy stand of alfalfa as a smother crop for the eradication of these weeds cannot be overemphasized. Since most farmers usually produce some alfalfa, this crop probably is the logical one to use in most instances.

In order to establish a heavy stand it often is necessary to apply agricultural limestone and manure. The land is prepared and the alfalfa is sown in the usual way, with or without a nurse crop. Where the weed population is very heavy, it is highly desirable to summer fallow the land for one season to thin out the weeds sufficiently to establish a stand of alfalfa. The action of the alfalfa roots competing with the weed roots, coupled with the repeated cutting of the tops, soon will reduce even the worst weed infestation. If a heavy stand of alfalfa is secured and maintained, experience has shown that the weeds will be entirely killed out by the end of the third season.

Sorghum, Millet, Sudan Grass, Soybeans and Drilled Corn

These summer smother crops, drilled or planted in rows so that cultivation can be practiced until the ground is well shaded, are recommended for individuals who desire crops other than alfalfa. Cultivation should be with cultivators equipped with sweeps or duckfoot shovels. These cut off more weed roots during cultivation than do the ordinary shovels. This method, being only annual in nature, must be repeated for 2 to 3 years to permanently kill the weed infestation. Provisions should be made to fertilize the area to keep up its productivity. This method, since all the above crops are planted late, allows for a few weeks of fallowing in the spring before the crop is planted and again in the fall after it is removed.

Research has shown that drilled soybeans are a very effective smother crop. An excellent plan of procedure is to plant small grain on the infested area. The heavy weed patches should be clipped early enough to prevent any weed seed production. The clippings may be fed to cattle to salvage desirable feed. In this way no crop is actually lost. The stubble should be plowed as soon as the crop is removed, cultivated at 10-day intervals (or whenever new weed shoots appear) until frost, using a surface (duckfoot) cultivator or spring tooth harrow. Cultivations are resumed in the spring when the weed shoots appear. The ground is plowed about May 30, a firm seedbed prepared and immediately (same or following day) drilled to inoculated soybeans at the rate of 3 bushels to the acre. The crop is harvested for hay or beans at the usual time, the land is plowed immediately and fallowing operations resumed. The program is repeated until the weeds are eradicated. Sorghum, sudan grass, or millet may be used in the same way as soybeans. All annual smother crop programs should be repeated for at least 2-3 years in succession but should eventually be followed by a heavy stand of alfalfa as discussed previously.

Rather than leave the ground bare, many farmers prefer to sow a cover crop like rye or winter wheat. This is especially desirable on erodible soils and extremely rolling areas. Such a cover crop furnishes late fall and early spring emergency pasture in addition to furnishing a soil cover during the winter and spring months, a valuable asset on any land, especially that subject to erosion. When the weeds appear in the late spring the

ground is plowed and fallowed and the annual smother crop program is continued. If the cover crop is to be plowed down in the spring, very heavy spring pasturing is desirable.

Soybeans, because of their tendency to loosen the soil, should not be used on extremely rolling areas. On slightly rolling ground somewhat subject to erosion, soybeans should be drilled on the contour. A winter cover crop following soybeans also is highly advisable. The cover crop should be plowed down the following spring when the weeds appear and soybeans repeated as a smother crop. Alfalfa should eventually follow the entire program. It is best, insofar as is possible, to use the soybean-fallowing method only on relatively level areas and to use sorghum, sudan grass or millet on the more erodible areas. If all planting is done on the contour then the method may be used on slightly more rolling areas.

Field Bindweed (Creeping Jennie), Perennial Peppergrass, Leafy Spurge and Russian Knapweed

Soybeans

Soybeans constitute one of the best smother crops to use on land infested with these weeds. The use of drilled soybeans and fallowing is a direct outgrowth of experimental work done on field bindweed (creeping Jennie) at the Iowa weed laboratory at Cherokee.

Specific cultural practices add tremendously to the value of soybeans as a smother crop. It is absolutely necessary to follow these recommendations as closely as possible. The following time-and-labor-saving practices should be observed and followed as closely as weather conditions permit, so that maximum damage is done to the weeds with a minimum of effort. Essential steps involved when soybeans are used as a smother crop for these weeds follow:

1. Start the eradication program by seeding small grain and plowing the stubble as soon as the crop has been harvested.
2. Cultivate the ground at 10-day intervals (or whenever new weed shoots appear). Continue cultivations until frost, using a surface (duckfoot) cultivator or spring-tooth harrow.
3. Resume cultivations in the spring when weed shoots appear.

Plow the ground again about May 30, *immediately* prepare a firm seedbed, and the *same or following day* drill in inoculated soybeans at the rate of 3 bushels per acre.

4. Harvest the crop for hay or beans at the usual time, plow immediately, repeat the process beginning with step 2.
5. Repeat the program each year until the weeds are eradicated. More than 1 year is required to eradicate these deep-rooted weeds.

On slightly rolling ground which is somewhat subject to erosion, soybeans should be drilled in on the contour. To further alleviate danger from erosion on such areas, the soybeans may be harvested early so that rye may be seeded immediately as a cover crop in early October. The rye is thus used as a cover crop to guard against erosion, may be pastured to some extent in fall and spring, and then plowed down in the spring in time to drill in soybeans again. When infested areas are handled in this way, danger from soil erosion is alleviated and soybeans may be used as a smother crop for these weeds even on somewhat rolling areas. On extremely rolling ground, however, neither summer fallowing nor soybeans are recommended. Confine their use, insofar as is possible, to the more level areas where danger from excessive soil erosion is negligible.

Sorghum, Sudan Grass, Millet

These smother crops may be used in exactly the same way as soybeans, which are discussed just previously. They can be used on level areas as well as on the more rolling areas where the use of soybeans is not to be recommended because of their tendency to loosen the soil and cause erosion. Use sorghum, sudan grass or millet on any soils subject to erosion, where soybeans should not be used. All of these smother crops are sown late and this permits of fallowing operations before the crop is planted and after it is removed. These fallowing operations are very important and highly detrimental to weed growth. Such fallowing operations in early spring and fall tend to kill many annual weeds so that the annual weed problem is much alleviated in such areas, and it is possible to drill in and produce these crops without a great deal of interference from annual weed growth. If it is desired to plant sorghum, sudan grass, millet or soybeans in rows, however (on rolling areas plant on contour),

then all cultivations should be by means of duckfoot shovel attachments since these serve to keep perennial weed growth, as well as annual weeds, down to a greater extent. Cultivation operations should be thorough and continuous until the crop effectively shades the space between rows.

Winter Rye and Winter Wheat

Summer fallowing combined with rye or winter wheat has been found effective in reducing the stand of European bindweed, perennial peppergrass, leafy spurge and Russian knapweed. Winter wheat is a better cash crop than rye but is not as hardy nor will it withstand as much pasturing as rye. In using rye or winter wheat it is advisable either (1) to seed the area to spring-seeded small grain and follow this by early harvest, plowing and summer fallowing, or (2) to fallow the area from spring to fall before planting the rye or winter wheat in the fall. All fallowing operations should be done with implements equipped with duckfoot shovels. These are much more effective in cutting perennial weed roots than are the regular shovels. The crop may be pastured lightly in the fall. In the spring, one of two methods may be used: (1) The area may be pastured heavily as emergency pasture, or plowed down as green manure and summer fallowing operations again started, or summer smother crops such as soybeans, sorghum, sudan grass or millet may be sown. After summer smother crops the area should be plowed early enough in the fall so that several cultivations can be applied to the weeds before rye or winter wheat is again sown. The other alternative (2) is to pasture lightly in the spring and remove the crop as a cash crop when mature, plow and summer fallow until time to plant rye or wheat again. The land, whenever it is not in crop, should be kept fallowed since this is an extremely important part of the program. Whatever suitable program is worked out by the farmer to fit his individual needs and weed control program, whether it involves rye, winter wheat, summer smother crops or summer fallowing, it must be continued until the weeds are under control. Often, after 1 or 2 years of winter wheat or rye, it is advisable to change to soybeans, sorghum, sudan grass, or millet, as described previously. Even after the weeds have been eliminated it is necessary to watch the area carefully to prevent reinfestation from dormant

seed in the soil, which may germinate under favorable conditions. A little extra effort for a few years to prevent such reinfestation will pay big dividends. When planning smother crop programs for extensive areas, it is best to consult your county extension director or your local county weed commissioner, or write to the Extension Service at Ames, Iowa.

Quack Grass, Milkweeds and Devil's Shoestring

Sorghum, Millet, Sudan Grass and Soybeans

For these three comparatively shallow-rooted weeds, the spring-tooth harrow is recommended. Plowing the area in the hot, dry summer months and working repeatedly whenever new growth presents itself is one of the best methods of eradication. Such repeated working during July and August on hot, dry days is very damaging to the roots of these weeds. The following spring, after a few more operations of the spring-tooth harrow, a summer smother crop of sorghum, millet, sudan grass or soybeans is planted and cultivated with implements equipped with duckfoot shovels until the crops effectively shade the ground between the rows. Broadcasting and drilling these crops for hay also are recommended. A uniform cover of the land with a smother crop is frequently preferable in that no summer cultivation is required. Soybeans are advisable on quack grass areas but are not as good as sorghum, millet or sudan grass on land infested with devil's shoestring or milkweeds. Early plowing, as soon as the smother crop is removed, is to be recommended. One year of this method usually is sufficient to kill even the worst infestations of these weeds, but if any remain, the method may be repeated a second year.

PASTURING

Pasturing with sheep, cattle and hogs is a method that has proved to be of some value in the destruction of certain weeds. At the Hawarden field station it was found that hogs confined in a patch of field bindweed will eat the rootstocks near the surface and prevent top growth, thus reducing the weed population. Close pasturing for 2 years with cattle or sheep will usually destroy wild morning-glory and control quack grass so that no seed is produced. Quack grass when pastured need not be treated in any other way until the land is plowed for cropping.

Wild sunflower, goat's beard, burdock and sour dock are other common weeds which may be controlled by pasturing.

WEED BURNERS

Weed burners of various types have been used extensively in different parts of the country with varying amounts of success. Burning, to be effective, must be done often enough to prevent food storage in the roots of the plant. If this is done, the roots eventually will starve and the plant will die. If the plant happens to be an annual, one burning usually is sufficient to destroy the plant. On railway roadbeds where the annual weed problem is severe, weed burners are quite effective. On perennial weeds, several burnings usually are necessary before complete control is obtained. It thus is necessary to consider the type of weed in question before control measures with weed burners are undertaken. Usually this method cannot be used on large infestations, especially of the noxious weeds. Haphazard use of burners on weeds not suited for this means of eradication might lead to further spread rather than to elimination. If weed burners are used, they must be used conscientiously and often enough to prevent any weed top growth. If all weed top growth is kept down by repeated burning as often as necessary, the weeds eventually will be killed. The number of burnings necessary to accomplish this varies with the different weeds.

MISCELLANEOUS METHODS OF WEED CONTROL

It often is possible to control small weed infestations by covering them with straw stacks, by deep piling of manure, by covering with tar paper or sheets of old tin, or by salting cattle on such areas. All these are methods of control which at best are applicable only to small areas and certainly are not to be recommended for large, extensive infestations. While most of these methods have some merit on small areas, their use cannot be recommended for extensive areas when we have much more dependable methods at our disposal such as recognized cultural control practices involving the use of summer smother crops or summer fallowing, or recognized chemical control practices. A method which may work very effectively for one area may not be suited to another. Unless done conscientiously, such methods often serve to spread, rather than eliminate, weeds. It is far

better to adopt a good sound, effective weed control program designed to fit your individual needs and involving recognized control methods, than to gamble with unknown methods which may or may not yield results.

CHEMICAL WEED KILLERS

Many substances have been used in the past for weed-killing purposes. Some have been used for a long time, others are of comparatively recent discovery. Among the chemicals which are used for weed-killing purposes at the present time are such substances as iron sulfate, sodium arsenite, sodium chloride (common salt), sulfuric acid, carbon bisulphide, tetrachlorethane, ammonium sulfamate, sulfamic acid, Sinox, borax, sodium chlorate and Atlacide. Future research probably will add others to this list. A brief discussion of the merits of each follows.

Iron Sulfate

Iron (ferrous) sulfate has been used to some extent in spraying small grain fields for the destruction of plants of the mustard family. It was one of the first selective sprays used in weed eradication. This chemical is only slightly harmful to plants of the grass family but decidedly injurious to broad-leaved weeds such as mustards, wild buckwheat, lambsquarters, etc. Since iron sulfate is a by-product of certain industries, its cost usually is quite low, making large-area application possible. The solution must not be spilled on foundations, sidewalks, metal objects, shoes or clothing, since rusty brown stains will result. There is no danger of fire when using this chemical.

The chemical should be dissolved in water and the solution strained before it is put into the sprayer, otherwise undissolved particles will clog the nozzle. A pressure sprayer, such as a power machine, knapsack or wheelbarrow sprayer should be used in making applications. The solution should be applied as a fine mist at a pressure of 80-100 pounds. The spray is most effective when the air is humid and should be applied on a cool, cloudy, quiet day. Rain should not follow application for at least a day, otherwise the chemical is washed from the leaves before it harms the plant. Iron sulfate should never be applied on a hot, dry day, since the solution will dry rapidly and the

sulfate crystals will fall from the leaves before damage has resulted.

For spraying small grain fields, a solution of 100 pounds of iron sulfate in 50 gallons of water is recommended. The sprayer should be adjusted so that 50 gallons of this solution will cover an acre. The weeds should be sprayed when small, namely from 3-6 inches high. Spraying grain fields with iron sulfate has never been tried to any extent in Iowa, but is a common practice in Europe, in the New England states and in North Dakota.

Iron sulfate also has been recommended for the control of dandelions and other lawn weeds such as chickweed and ground ivy. The chemical is dissolved at the rate of 2 pounds to 1 gallon of water and this amount applied on 400 square feet of lawn. The first application should be made in early spring before the plants blossom. From 3-6 applications at 10-day intervals usually are necessary. Avoid spraying during hot, dry midsummer weather. Mow the area 2-3 days before spraying and 2-3 days after spraying. The grass will be blackened temporarily after each application. Bare areas should be fertilized and reseeded with good, approved lawn mixtures.

Sodium Arsenite

Sodium arsenite is sold commercially in a highly concentrated liquid form. The amount of dilution is determined by the plants to be treated. For some plants, 1 pound per 25 gallons of water is sufficient, but for the more resistant plants 2 to 5 pounds are required. It kills the tops of Canada thistles and morning-glories but does not kill the underground roots unless several applications are made as often as the new growth gets up enough to receive the spray. This chemical simply keeps the tops down and in that way starves the roots by preventing food storage. *Sodium arsenite, even in small quantities, is deadly poisonous to livestock and man, and for that reason its use should be discouraged.* If it is used as a soil drench in large enough quantities to kill the roots, the soil is rendered unproductive for a number of years.

Sodium Chloride or Common Salt

During the past few years salt has been used to kill barberry plants by applying large quantities of it around the base of the

bushes. It also is effective in killing buckthorn plants when applied in August. From 1 to 25 pounds are required per plant, depending upon the size.

Salt will not kill perennial weeds unless it is applied in large enough quantities to saturate the soil around the roots. This treatment injures the soil for a number of years. Small quantities of salt fed to cattle on a patch of Canada thistle often results in the death of this weed.

Sulfuric Acid

Sulfuric acid has been used experimentally and has been found more effective in killing mustard plants under more varying conditions than has iron sulfate. A solution containing ¼ to 2½ ounces of commercial sulfuric acid per gallon of water will kill mustard plants in a few hours, even in a dry atmosphere, without injury to oat plants. The cost of the acid would be high for extensive use on large areas. Small quantities applied several times in a season to small areas of Canada thistles are effective in eradicating them.

Carbon Bisulphide

This chemical has been used for some time for weed-killing purposes. It is effective when used under proper conditions. Since it is tedious to apply and the cost is relatively high (as much as $1.00 per square rod) its use on large areas is prohibitive.

Before treating an area, all plant growth should be cut below the ground and raked from the plot. All new shoots should be destroyed as they appear. This may be done by hoeing or surface cultivation. Holes about 1 inch in diameter and 8 inches deep are then made at 18-inch intervals in rows that are 18 inches apart. The holes should be staggered so that those in every other row are opposite each other. The holes may be made by any type of sharpened implement or by special commercial applicators designed for this purpose. The entire patch, including an area at least 5 feet beyond the last plant, should be treated in this manner. Two ounces of carbon bisulphide are poured into each hole and the opening closed by thorough tamping. This tamping is very important and must be done if good results are to be secured. A metal tamp should never be used

since sparks may result from striking stones in the soil and the chemical may become ignited with resultant explosive violence. The chemical, under ordinary conditions, forms a heavier-than-air gas which penetrates downward, killing all forms of plant and animal life as it proceeds.

As already intimated, carbon bisulphide is a very inflammable liquid. It is absolutely imperative that sparks and fire be kept away while treatment is being made. The fumes are toxic when inhaled. Anyone constantly exposed to the fumes should wear a respirator. Carbon bisulphide should never be poured or used inside any building.

Tetrachlorethane

This chemical, only recently adapted for weed-killing purposes, is used in exactly the same way as carbon bisulphide. In general, it has been found to be a better weed killer than carbon bisulphide since it is more reliable in its action, more tolerant of various weather conditions and non-inflammable. When large-scale production is undertaken, this chemical probably will become sufficiently reduced in cost to warrant its general use as a herbicide.

Ammonium Sulfamate and Sulfamic Acid

The herbicidal action of these two products is of only recent discovery. Additional experimental work needs to be done to determine their herbicidal effectiveness on various plants. Recent experiments seem to indicate that for certain weeds at least their use may be justifiable. Ammonium sulfamate is known to be quite toxic to poison ivy. Furthermore its action in the soil is not toxic to other plants, consequently it is possible to spray poison ivy under fruit trees, among grapes, etc., without producing any ill effects on the crop plants, providing the chemical is kept off foliage and stems of the crop plants.

For the control of poison ivy ammonium sulfamate is mixed at the rate of 1 pound to a gallon of water and this amount applied to a square rod of vegetation, using a pressure sprayer so as to thoroughly cover all plants. The chemical is non-hazardous as pertains to fire or livestock poisoning.

Sinox

Sinox is a recently developed, non-corrosive herbicide that is recommended and used for the selective control of broad-leaved annual weeds along roadsides and in small grain, flax, alfalfa, onions, peas and corn. It is applied with a pressure sprayer to insure uniform, thorough coverage. Spraying can be done at any time of day. Best results are obtained by spraying young, succulent growing plants during good growing conditions of abundant soil moisture and high air humidity and temperature. The young weeds that are to be sprayed should be 2-3 inches high and have from 2-7 leaves. Spraying prior to rains, during extended periods of drought, low temperatures or cold, drying winds should be avoided.

For spraying such plants as wild mustard, yellow mustard, fanweed, nightshade or vetch, one gallon of Sinox is mixed with 100 gallons of water and applied at the rate of 80-100 gallons per acre. This usually is sufficient to secure a good kill. For black mustard, smartweed, knotweed, pigweed and jimson weed, one gallon of Sinox dissolved in 80 gallons of water and applied at the rate of 80-100 gallons per acre is required. For other annual weeds, the chemical is dissolved at the same rate but applied at the rate of 300 gallons per acre.

For spraying large areas such as small grain fields, special equipment is necessary. When spraying is completed, all equipment used should be thoroughly washed. The dry, solid ingredients of Sinox are inflammable and must be removed from equipment and clothing. Operators who use this material for spraying and who are constantly exposed to the spray fumes should wear respirators. Spraying large areas of small grain has not been done extensively in Iowa, but is being done with rather good results in the western states of California, Oregon and Washington.

Borax

Limited experiments with borax indicate that rather large amounts must be used in order to secure herbicidal action. This would result in at least partial soil sterilization, thus making the land unproductive for an extended length of time. Many crop plants are very sensitive to high concentrations of this material. For driveways, roads, tennis courts, around storage

tanks and warehouses, railroad yards, etc., such sterilization should be an asset rather than a handicap. More experimental work needs to be done before extensive recommendations can be made concerning this material. The chemical may be applied dry at the rate of 8-15 pounds per square rod. It is non-hazardous as far as fire or livestock poisoning is concerned.

Chlorates

Discovery of the value of chlorates as herbicides opened up new possibilities for weed control by chemical means. Prior to this discovery, chemicals had been used only to a limited degree. With the advent of chlorates, however, chemical weed control gained greatly in favor. Chlorates are well adapted to roadsides, ditchbanks, fencerows, railroad lands and stony areas, as well as to small patches in fields, gardens and waste land. The total amounts of sodium chlorate and Atlacide (a chlorate product) used in Iowa in recent years have increased as follows:

1935— 400,000 pounds
1936— 611,000 pounds
1937— 769,000 pounds
1938— 800,000 pounds
1939—1,060,000 pounds
1940—1,112,000 pounds
1941—1,311,000 pounds
1942—1,028,000 pounds
1943—1,028,000 pounds

During 1942 and 1943, the amount sold in Iowa was limited by government restriction.

The value of the chlorates as weed killers was discovered in Europe where they have been used in both liquid and dry form on Canada thistles. The exact action on plants by this class of chemicals is not known, but they are far more destructive to the roots of perennials than are any of the other substances described above. Chlorates have the ability to kill the tops of a large number of plants and at the same time work down to the roots, killing them gradually. (See fig. 57.) There are two types of chlorates commonly used in Iowa, sodium chlorate and Atlacide.

Sodium Chlorate

There are several different chlorate compounds, but sodium

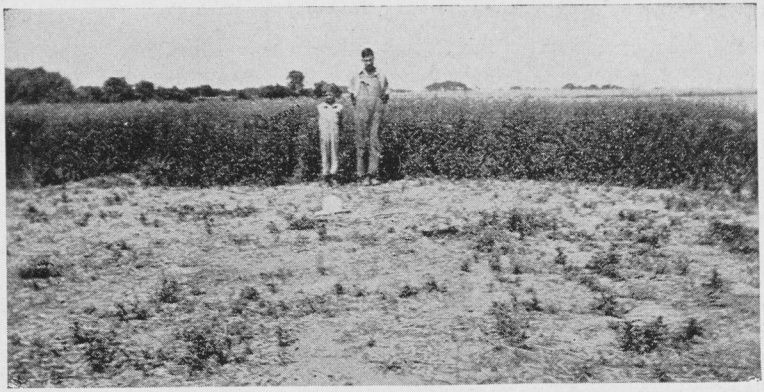

Fig. 57. Effect of sodium chlorate on thistles.

chlorate is the only one that can be made at a price sufficiently low to justify its use as a weed killer. Its only shortcoming is its inflammability. Sodium chlorate is a powerful oxidizing agent and is used extensively in the manufacture of munitions and fireworks. Every year, someone using sodium chlorate as a weed killer neglects the precautions cited in a later paragraph, and a fire results. During 1937, 35 county agents reported the use of 535,500 pounds of chlorate in their counties. The users experienced four fires; fortunately no personal injury occurred. It always should be remembered when using chlorate that it is inflammable when combined with dry organic matter as lumber, shoes, clothing and plant refuse. The precautions listed below should be practiced in every detail.

Atlacide

Recently there has been placed on the market a weed killer having a sodium chlorate base, known under the trade name of Atlacide. Mixed with the chlorate are other chemicals that markedly decrease the burning of dry weeds, clothing, shoes, lumber and plant refuse. Atlacide has been on the market for several years and has been found in practice to be equally as efficient a weed killer as sodium chlorate. In 1937, 24 county agents and 27 division engineers of the Iowa Highway Commission used over 234,000 pounds and obtained a satisfactory kill without a single fire.

Atlacide usually retails at the same price per pound as sodium

chlorate. It is recommended that Atlacide be used instead of sodium chlorate because of its reduced fire hazard. It is dissolved and applied in the same way as sodium chlorate. Distributors in the state carry stocks of Atlacide as well as sodium chlorate. Since Atlacide has a high chlorate base, it is well to subject its use and handling to the same precautions as the straight sodium chlorate.

Precautions with Sodium Chlorate

The following precautions should be observed in handling chlorate:

(1) Do not use sodium chlorate near buildings, and keep the steel container closed when not in use.
(2) Do not allow dust, chaff or other organic matter to become mixed with chlorates.
(3) Keep the floors of truck or wagon boxes and all wooden parts of the spray machine well painted.
(4) Wash clothing saturated with chlorates in water before wearing again.
(5) Thoroughly rinse out spray machine in which chlorate has been used before spraying trees or plants for protection against insects and disease-causing organisms.
(6) Do not spray during periods of heat and drouth.
(7) Do not mow areas to be treated just before weeds are sprayed.
(8) Do not cut or burn plants soon after they have been sprayed. There may be a progressive killing of the roots which is more rapid and complete when the tops are not removed.

Rate of Mixture

Atlacide and sodium chlorate should be used in liquid form for summer treatments. Solutions are prepared by dissolving 1 to 1½ pounds of the dry salts in each gallon of water. They will dissolve more readily in warm water than in cold water and the more finely ground grades dissolve more easily than the coarse crystalline ones.

Time of Application

Spraying with Atlacide or sodium chlorate is most effective if applied when the following conditions prevail: (1) Abundant

succulent foliage providing a large absorptive area; (2) plants in the bud or early blossom stage; (3) abundant soil moisture and high humidity. Spraying should be done on cloudy days or in the evening, to avoid evaporation from plants after treatment.

Table 7 indicates, in a general way, the time of application. The time varies, however, in different parts of the state as well as from one season to another. The farmer should watch the state of development of the weeds as to blossoming and carry out the recommendations listed.

Rate of Application

Rate of application is dependent on the kind of plant and on the amount of foliage. A dense stand of thistles growing in fertile soil will require more solution per square rod than will thistles growing in a bluegrass pasture where the stand is light. Field bindweed, leafy spurge, Canada thistle, perennial sow thistle, perennial peppergrass and quack grass require from 1 to 3 gallons per square rod for the first treatment and less for each subsequent treatment. Horse nettles usually grow in scattered clumps and require less solution per square rod than most other weeds. The important thing is to thoroughly wet all of the leaf surfaces in each application, even though this requires 2 to 5 gallons per square rod. Spraying is frequently more successful if rye or millet is sown in bindweed-infested areas. The

TABLE 7. APPROXIMATE TIME FOR APPLYING ATLACIDE OR SODIUM CHLORATE TO VARIOUS WEEDS.

Name of weed	Time for:		
	1st treatment	2nd treatment	3rd treatment if necessary
Canada thistle	June 15-25 Bud stage	September New shoots 6 inches high	September-November Treat scattered plants individually
European bindweed	June 20 (in bloom)	September	"
Horse nettle	July 10-20	September	"
Leafy spurge	May 25-June 10 (As it starts to bloom)	When new shoots are coming into blossom	"
Perennial peppergrass	May 20-June 1	September	"
Perennial sow thistle	June 15-25	September New shoots 6 inches high	"
Quack grass	June 10-25	September	"
Russian knapweed	June 10-25	September	"

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bindweed plants climb on the rye and millet, and better coverage of the weeds is accomplished.

Methods of Application of Chlorates in Solution

Small patches of weeds may be sprayed by using a knapsack or compressed air sprayer in a 3-, 4- or 5-gallon size. (See fig. 58.) It is convenient to carry but is not designed to give high pressure. There is also a wheelbarrow type of spray machine with a capacity of about 10 gallons. (See fig. 59.) It is equipped with a strong pump, pressure gauge and sufficient length of hose to allow a radius of at least 10 feet in which to operate without moving the machine. A regular barrel sprayer or power outfit, such as is used for orchard spraying, is very satisfactory for larger areas. The chlorate should be thoroughly rinsed out of the sprayer each time after chlorate solution is used, because the chlorate corrodes metal. Many counties own power sprayers which they make available to their farmers for a nominal charge. Under the direction of the county weed commissioner, excellent results are obtained in spraying.

Fall Application of Dry Sodium Chlorate

Spraying should be done only when there is plenty of moisture and high humidity. Sometimes during the summer months such conditions do not prevail. Inasmuch as rainfall is more certain in the fall months, fall treatment with dry chlorate may be advisable. Applications may be made in late September or October. The rate of application depends on the weed in question, ranging from 2 pounds per square rod for quack grass to 5 pounds for bindweed, perennial peppergrass and horse nettle. Scattered plants of horse nettle also may be treated individually with a teaspoonful of chlorate per plant. Chlorate may be scattered by hand as in sowing grain or by means of a gallon

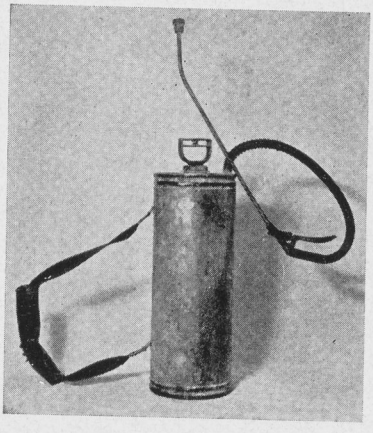

Fig. 58. Compressed air sprayer.

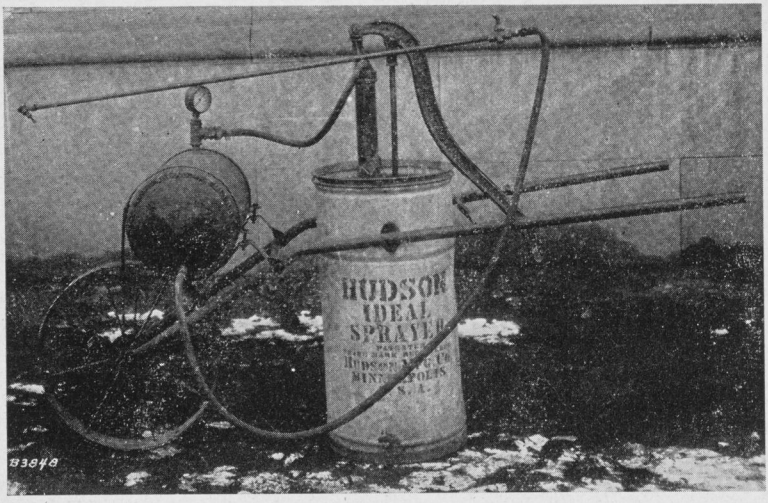

Fig. 59. Wheelbarrow sprayer.

bucket, perforated in the bottom and nailed to a stick, which should be shaken uniformly over the area. Commercial, wheelbarrow-type applicators are also available. These scatter the dry chemical evenly as they are pushed over the ground.

Effect of Chlorates on Soil and Livestock

The effect of chlorates on the soil and on livestock is not completely understood. In a few cases where heavy applications have been made in Iowa the soil has been somewhat nonproductive the next season. The effect, however, seems to be dependent on the amount of rainfall in the summer, fall and spring following the treatment. Whatever the effect, it is not permanent. Corn planted late in May or early June does relatively better on chlorate-treated areas than do small grains planted earlier. Alfalfa and sweet clover are tolerant to chlorates but soybeans are not.

The possibility of livestock poisoning also should be considered. There have been livestock losses reported where animals were extremely salt hungry and where they were allowed access to newly sprayed patches of weeds. When weeds are sprayed in pastures, *play safe*, fence or keep out all livestock until after at least one heavy rain. If this cannot be done, be

positive that plenty of salt has been kept constantly before the animals for at least a week previous to the spraying. The farmer must be his own judge, since certain animals (especially hogs and chickens) have been reported as being quite susceptible to common salt poisoning. Under no circumstances should any animals be allowed access to the solution in barrels, or to the dry chemical in containers.

When Should Chlorates Be Used?

The cost of killing quack grass, Canada thistle and other perennial weeds with chlorates has ranged from $15 to $50 per acre. It is apparent, therefore, that for large areas of perennial weeds the use of chlorates is not advisable, especially whenever it is possible to cultivate and grow a crop. For fence lines, roadsides, timber or other permanent pastures or for small spots in cultivated fields the use of chlorates is justified. For large infestations, smother crop programs are advocated. These have been discussed previously.

Miscellaneous Materials Used in Weed Control

Creosote, various oils such as kerosene, gasoline and crankcase oil, Lewis lye and other strong alkalies, "gas drippings" from coal gas manufacturing plants, as well as other materials, all have been used as herbicides either in the form of sprays, individual spot treatments or as soil drenches. Generally speaking these materials kill only the tops of the plants. If the plants are annuals, the treatment is often quite effective. On perennial weeds it kills the tops but usually does not kill the underground roots unless done often enough to keep the tops completely down, thereby starving the roots and eventually killing the weed. If these materials are used as a soil drench, it is necessary to apply rather large quantities in order to kill the roots. This treatment usually renders the soil unproductive for several years. This may be desirable along certain driveways, in railroad yards and in railroad beds, around buildings such as warehouses or oil storage tanks, but permanent soil sterilization is not advisable on agricultural land where it is desired to plant subsequent crops. When the number of weeds to be eradicated is small, individual spot treatment or cutting the plants a little distance below the soil surface, followed by the application of the material directly

on the underground root, is often quite effective. None of these materials, however, are as effective and reliable as the recommended herbicides, sodium chlorate or atlacide.

DEVELOPMENT OF A COMMUNITY PROGRAM

Since more than 50 percent of the farms of Iowa are tenant-operated, it is obvious that no satisfactory community program can be developed without solving the weed problem on these rented farms. In addition, many owner-operated farms need attention in order to make the program complete.

One of the most important factors in the development of a community program for weed control is the organization and perpetuation of an educational campaign in each county consisting of: (1) An organized group that will take the responsibility of keeping the subject of weed control before the public constantly; (2) the establishment of a demonstration on at least one farm in every township, illustrating methods of eradication; and (3) the dissemination of information by circular letters, news stories, bulletins and township or county meetings.

The county farm bureaus are well equipped to promote and carry on such a campaign, but they need the support of the board of supervisors, the township trustees and weed commissioners. The board of supervisors has the responsibility of enforcing the weed law, but laws cannot be enforced without the moral support of the majority of the public; hence, the county officials and the farmers' organizations need to work together in promoting education on weed control. Every weed commissioner should familiarize himself with weeds and their control, aid in establishing successful demonstrations, give out information in public or private discussion and at all times urge the absolute necessity of community cooperation as the first step in the weed program. It also is essential that the supervisors, trustees and weed commissioners outline and agree on a common goal so that all commissioners will be working toward the same end.

If such a campaign as described above is carried on in any county for several years, it will be much easier to enforce the provisions of the weed law* on those individuals who steadfastly

*For information on the Iowa Weed Law write to the State Secretary of Agriculture in Des Moines.

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refuse to cooperate for the good of the community. More than half the counties in Iowa have already made a beginning on a county-wide program of the type described above and the results are very gratifying.

The establishment of the agricultural adjustment program which may be continued in some form for many years affords an unusual opportunity to destroy weeds. Reduction of crop acreage should permit better farming and more effective control of weeds. Careful mapping of noxious weed areas by weed commissioners would form the basis of a future and more intensive control program. The active support of farmers in any weed control program is essential to its ultimate success.

LANDLORD-TENANT RELATIONSHIP

Successful control of weeds on tenant-operated farms is dependent on the type of relationship which the owner establishes with his tenant. Obviously the long-time lease is most conducive to a satisfactory weed control program, but in the final analysis the owner must accept the responsibility of solving the problem. When a man moves to a farm he should be made responsible for any patches of bad weeds that he allows to take possession of the land during his tenure, but he should not be expected to use labor for which he gets no return in killing noxious weeds that have been allowed to establish themselves prior to his term of leasing. If a crop can be grown and reasonable returns secured, however, the tenant ought to put in the necessary labor to grow the crop.

The landowner could donate the crop that can be grown on patches infested with persistent perennials to the tenant for 1 or 2 years provided the tenant will put in the necessary labor for the destruction of the weeds in question. For large areas some division of the crop is preferable. If cash rent is collected, the owner might pay the renter a sum agreed upon by both parties for the extra labor involved. It also is possible to grow a crop and spray the noxious weeds in August, September or later. With this plan the owner might buy the material and the tenant do the spraying. Whatever the plan, it is evident that the principle of joint responsibility must be recognized and the weed control program undertaken on that basis.

USE OF AAA PROGRAM IN WEED CONTROL

The present regulations of the AAA program permit compensation for certain practices that are essentially good weed-control methods. By proper application of these regulations farmers may kill weeds and improve their cropland at the same time. County extension directors, county soil conservation committees and AAA committees should be consulted for information.

IMPORTANCE OF WEED IDENTIFICATION AND ERADICATION OF NEWLY DISCOVERED AREAS

Our present weed problem is caused in part by the fact that individuals have been slow to recognize and eradicate small areas of new weeds when first discovered. Such small areas if undisturbed soon increase in size and eradication becomes a real problem. It is desirable that every individual as well as agricultural societies, vocational agriculture classes and commercial clubs acquaint themselves with the different kinds and types of weeds found on their land or in their communities. Whenever a new weed makes its appearance it should be taken to the county extension director, or sent to the Extension Service, Iowa State College, Ames, Iowa, for identification. Eradication of even the worst weeds is comparatively simple when the patch is small. When such patches are allowed to spread and produce seed, the weed soon becomes a real menace to an agricultural community. All agricultural seed should be cleaned and tested before it is sown. This insures freedom from noxious weeds. If this had been done years ago, our weed problem would not be as serious as it is now.

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Cooperative Extension Work in Agriculture and Home Economics, Iowa State College of Agriculture and Mechanic Arts and the United States Department of Agriculture cooperating. Extension Service, R. K. Bliss, director, Ames, Iowa. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts, R. E. Buchanan, director, Ames, Iowa.

Weed Seed and Plant Collection

Many students of vocational agriculture, as well as 4-H groups, garden clubs and private individuals interested in nature and plant lore, request information on making plant collections. Making a plant or weed seed collection is interesting as well as instructive work. If properly made, organized groups or individuals can derive a great deal of satisfaction and intimate knowledge of plants from such collections. These collections can be used very effectively at exhibits, displays, etc. The brief directions below will help individuals or groups to make such a collection.

1. WEED SEEDS

Collect all weed seeds when mature. Allow to dry thoroughly before placing in small vials. Add a few crystals of paradichlorobenzene (moth crystals) and insert a small but legible label identifying the seed, noting plant name, plant family, date and collector's name. Small, suitable vials may be secured at most drug stores. Place all labels the same way in the vial, so that shallow exhibit cases, or shallow drawers can be used to exhibit the entire collection. This makes for greater uniformity and better visibility. Another way is to number the vials and record numbers and identification on a large placard. If gummed labels are used on outside of vials, be sure the surface of the vial is absolutely clean before placing label, otherwise the labels come off readily.

2. PLANTS

Make a simple plant press by taking two boards each 12 inches by 18 inches in size and cutting a dozen or more blotters of the same size. These can be made from "rug backing" sold by most furniture dealers for pads under rugs. Collect and press plants before they wilt. Spread out the plant in a single folded piece of newspaper. Place a blotter on the bottom board of the press and place the newspaper with the specimen on the blotter. Place another blotter on the newspaper, then another specimen, another blotter, etc. Finally place the board and a weight on the top. The weight should be sufficient to press the plants. Change blotters every day until the plants are dry. This prevents molding. Keep in a dry, cool, well ventilated room. Drying is usually completed in 4 to 7 days. Dry blotters by hanging in a well ventilated room or in the sun. These can be used over and over again.

When plants are dry, mount on strong, stiff, white paper. Glue plants to paper or fasten them by gummed strips. Placing cellophane over the specimen helps protect it. Many persons improvise cotton backing mounts in which most of

the top is cut out of hosiery boxes and replaced with glass or cellophane. Cotton is placed in the box, the dried specimen placed on it and the glass or cellophane cover replaced and fastened. Commercial (Riker) mounts are also available for this purpose. All mounts should be handled carefully and should not be placed in direct sunlight unless absolutely necessary. All mounts should also be placed in a closed box once or twice each year and treated for insects with moth-repellent crystals for 3 to 4 days.

An unlabelled plant is useless. A good label should have the following information:

1—Plant family (grass, rose, spurge, sunflower, etc.)

2—Common name of plant

3—Locality where found (meadow, roadside, pasture, timber, etc.)

4—County

5—Date and collector's name.

3. PLANTS FOR IDENTIFICATION

Specimens may be sent to the Extension Service at Iowa State College, Ames, Iowa, for free identification. Send at least one small entire plant, if possible, including stem, leaves, but above all flowers or fruit. Press the specimen, number it, and keep a duplicate. Identification will be by number. This makes it unnecessary to return the specimen.

Record of Noxious Weed Eradication

Most noxious weeds are deep-rooted and difficult to eradicate. It usually requires 2 to 3 sprayings or 2 to 4 years of smother crops to eradicate them completely. The following outline will help you keep a record of work done and progress made.

Weed..... Total infested areas:.....sq. rods or.....acres

Comments.....

.....

A. TREATMENT WITH CHEMICAL

First Treatment:

1. Date..... 194....
2. Stage of plant (buds, blooming, etc.).....
3. Weather .....
4. Chemical used.....
5. Amount of chemical per gallon .....

B. SMOTHER CROPS OR OTHER PRACTICES

First-Year Treatment:

1. Date of first operation ..... 194.....
2. Treatment (mowing, plowing, harrowing, etc.).....
3. Treatment immediately before seeding crop.....
4. Smother crop used.....
5. Rate of sowing.....

6. Amount of spray used per sq. rod .....
7. Vegetation: Dense ..... light .....
8. Reduction in weed ..... %
9. Comments .....

Second Treatment:

1. Date ..... 194 .....
2. Stage of plant (buds, blooming, etc.) .....
3. Weather .....
4. Chemical used .....
5. Amount of chemical per gallon .....
6. Amount of spray used per sq. rod .....
7. Vegetation: Dense ..... light .....
8. Reduction in weed ..... %
9. Comments .....

Third Treatment:

1. Date ..... 194 .....
2. Stage of plant (buds, blooming, etc.) .....
3. Weather .....
4. Chemical used .....
5. Amount of chemical per gallon .....
6. Amount of spray used per sq. rod .....
7. Vegetation: Dense ..... light .....
8. Reduction in weed ..... %
9. Comments .....

6. Date of harvest .....
7. Date of fall plowing .....
8. Reduction in weed ..... %
9. Comments .....

Second-Year Treatment:

1. Date of first operation ..... 194 .....
2. Treatment (mowing, plowing, harrowing, etc.) .....
3. Treatment immediately before seeding crop .....
4. Smother crop used .....
5. Rate of sowing .....
6. Date of harvest .....
7. Date of fall plowing .....
8. Reduction in weed ..... %
9. Comments .....

Third-Year Treatment:

1. Date of first operation ..... 194 .....
2. Treatment (mowing, plowing, harrowing, etc.) .....
3. Treatment immediately before seeding crop .....
4. Smother crop used .....
5. Rate of sowing .....
6. Date of harvest .....
7. Date of fall plowing .....
8. Reduction in weed ..... %
9. Comments .....

Weed Observation Record

The following outline is for your convenience. Use it to record the number of different weeds on your farm, lot, garden or lawn. Mark the ones which are the most difficult to eradicate. If there are some plants you do not know, you may send them to the Extension Service, Ames, Iowa, for free identification.

I. PRIMARY NOXIOUS WEEDS

1 .....
2 .....
3 .....
4 .....
5 .....
6 .....
7 .....
8 .....

II. SECONDARY NOXIOUS WEEDS

1 .....
2 .....
3 .....
4 .....
5 .....
6 .....
7 .....
8 .....
9 .....

III. COMMON HARMFUL WEEDS

1 .....
2 .....
3 .....
4 .....
5 .....
6 .....
7 .....
8 .....
9 .....
10 .....
11 .....
12 .....
13 .....
14 .....
15 .....
16 .....
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18 .....
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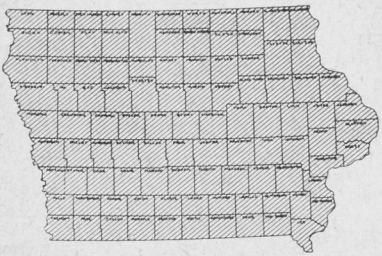
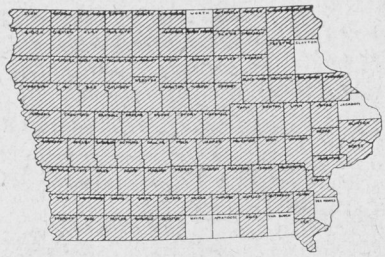
31 .....
32 .....
33 .....
34 .....
35 .....
36 .....
37 .....
38 .....
39 .....
40 .....

KNOWN DISTRIBUTION OF IOWA PRIMARY NOXIOUS WEEDS

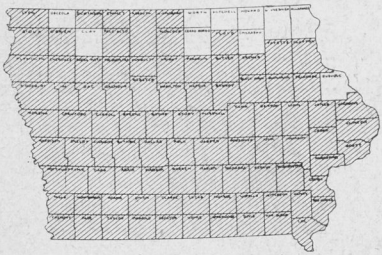
JANUARY, 1944



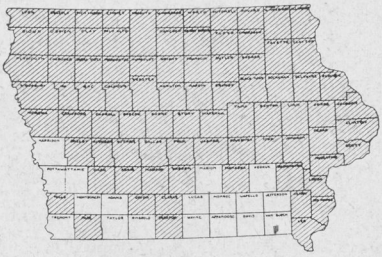
CANADA THISTLE - 99 Counties



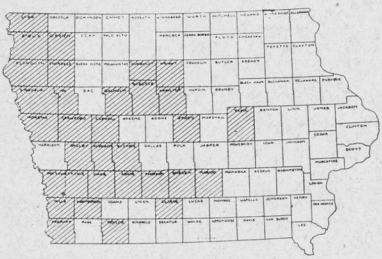
FIELD BINDWEED - 92 Counties



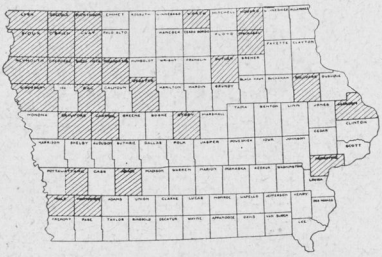
HORSE NETTLE - 89 Counties



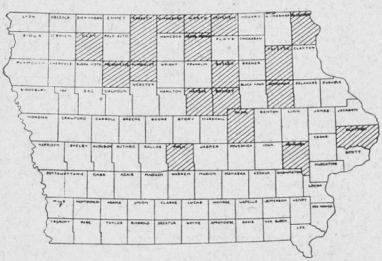
QUACK GRASS - 82 Counties



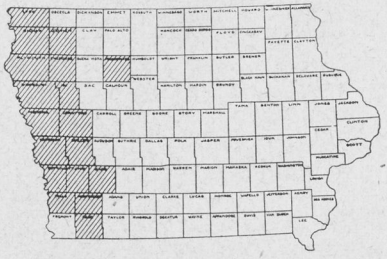
PERENNIAL PEPPERGRASS - 30 Counties



LEAFY SPURGE - 27 Counties



PERENNIAL SOW THISTLE - 18 Counties



RUSSIAN KNAPWEED - 17 Counties